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The Directive Function of Speech in Development and Dissolution

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Part I: Development of the Directive Function of Speech in Early Childhood*

Along with the semantic and syntactic functions of speech, it is necessary to distinguish also its pragmatic or directive function. In the development of behavior this function manifests itself in the fact that a word gives rise to new temporary connections in the brain and directs the system of activity of the child that has mastered it.

It was a full quarter of a century ago that the eminent Soviet psychologist L. S. Vygotskij pointed out the role played by the words of adults in the development of the child's mental processes and formulated his well-known thesis that what the child at first does with the help, and on the instructions, of the adult, he later begins to do by himself, supporting himself with his own speech; that speech as a form of communication with adults later becomes a means of organizing the child's own behavior, and that the function which was previously divided between two people later becomes an internal function of human behavior (Vygotskij 1934, 1956). In the twenty-five years that have elapsed since Vygotskij's death the problem of the role of the word in the organization of mental life has been the subject of numerous Soviet investigations (Rozengardt 1948; Ljublinskaja 1955; Luria 1955, 1956*a*, 1958; Kol′cova 1958; and many others).

There arises, however, the question of how this pragmatic, directive function of the word is formed, and how its formation relates to the formation of the significative or generalizing functions of the word. A brief review of the pertinent experiments forms the topic of the present communication.

* Part II, dealing with the dissolution of the directive function of speech in connection with pathological conditions of the brain, will appear in the next issue of WORD.

I

A child at the beginning of its second year of life is already in command of a considerable number of words. He understands such expressions as *cup*, *cat*, *fish*, *horse*, and can without difficulty hand someone the object if it is mentioned. But is the pragmatic, directive function of speech at this stage as effective as its significative, nominative function? Can the cited word always direct the child's activity with full effectiveness?

An answer to this question is suggested by the experiments which we have carried out in collaboration with A. G. Poljakova.

Before a child aged 1;2 to 1;4, we placed some object, e.g. a toy *fish*, and asked him to hand it to us; the child did this without particular difficulty. We then asked him, in the same situation, to hand us the *cat*. The child at first looked at us in disbelief, then began to look around until he found the object which had been named. It would seem that the adult word fully determined the child's action.

Let us, however, repeat this experiment in a somewhat more complicated situation. Let us place before the child two objects: a toy *fish* at some distance from it, and half way toward the fish a brightly colored toy *cat*. If in this situation we ask a child of 1;0 to 1;2 to hand us the *fish*, his behavior will be different. The uttered word will evoke in him an orientational reaction, and his glance will be fixed on the fish; but his hand, stretched out toward the fish, will stop half way, turn toward the cat, and instead of giving us the fish that was requested, the child will grasp the *cat* and offer it to the experimenter. The directive function of the word will be maintained only up to the moment when it comes into conflict with the conditions of the external situation. While the word easily directs behavior in a situation that lacks conflict, it loses its directive role if the immediate orientational reaction is evoked by a more closely located, or brighter, or more interesting object.

It is only at the age of 1;4 to 1;6 that this phenomenon disappears and the selective effect of words is maintained even in conditions in which the components of the situation conflict with it.

We can easily disturb the directive function of the word in still another way. It is known that the word physiologically excites a certain system of connections in the cortex. In the normal, mature nervous system these connections possess considerable mobility and easily replace each other. As has been shown in many investigations (c.f. Luria 1956*b*, 1958; Homskaja 1958), the mobility of the connections evoked by the word (or, as I. P. Pavlov called it, by the second signal system of reality), is even greater than the mobility of connections evoked by immediate signals.

However, the mobility of nervous processes in a very small child is still quite inadequate, and connections evoked by the word possess a considerable inertia at the early stages of development. Taking this inadequacy of the mobility of connections in the early stages of development as a premise, we can measure the effectiveness of the directive function of the word.

We place before a child of 1;0 to 1;2 two toys: a fish and a horse, this time placing them at the same distance and giving them dimensions and colors that are equally attractive. We ask the child to give us the *fish*: he does this easily. We repeat this experiment three or four times, and the effect remains the same. In exactly the same tone of voice, we now utter a different instruction and ask the child to hand us the *horse*. Despite the fact that the meaning of this word is well known to the child, the inertia of the connections evoked by the first word is so great that in many cases the child again offers the experimenter the fish. The directive function of the changed verbal instructions is here vitiated by the inertia of the connection that has been established.[1]

The loss of the directive function of a word whose meaning is well known can also be observed in an experiment involving actions designated by verbs. If we give a child of 1;2 to 1;4 a stick on which rings are placed and we instruct him, "Put on the ring," he does this easily. With equal ease he will, in another situation, execute the instruction, "Take off the ring." However, if the child has several times *put on* a ring and is holding the next ring in his hands, the instruction "*Take off* the ring" loses its directive meaning and begins to function non-specifically, merely accelerating the activity of *putting on* the ring onto the stick (Poljakova's and Ljamina's experiment).

The directive role of the word at an early age is maintained only if the word does not conflict with the inert connections which arose at an earlier instruction or which began with the child's own activity.

II

Experimental research can do more than ascertain the bare fact that the directive role of words is not fully effective at an early age. Such research can also *measure* the relative effectiveness of verbal signals as compared to the directive role of immediate, visual signals. In order to

[1] In a number of cases such an experiment may not give the desired results. This happens when the dominant role in the child's behavior continues to be played by the *immediate orientational response to objects*. In such cases the child will alternately hand the experimenter now this object, now the other, and the directive function of speech will fail to be exercised from the start.

make this comparison as vivid as possible, we pass on to some experiments with somewhat older children—aged from 1;4 to 1;6 on the one hand, and from 1;8 to 2;0, on the other hand.

Let us first establish how effective the orienting (attention-directing) and directive role of a visual signal and its trace can be at this stage. We place before a child two inverted objects, a cup and a tumbler of non-transparent plastic. As the child watches, we hide a coin under the cup, which is placed to the left, and we ask the child to "find" it. For a child of 1;4 to 1;6, this constitutes an interesting and meaningful task, which he solves without difficulty. We repeat this experiment three or four times, each time holding the coin under the cup within sight of the child. The solution will invariably be successful. Now, without interrupting the experiment, we change its conditions and hide the coin not under the cup on the left, but under the tumbler on the right. A certain proportion of children of the younger group will follow not the changed visual signal (more precisely, its trace), but the *influence of the inert motor stereotype*, and will put out their hands toward the cup on the left, carrying out the habitual movement reinforced in the previous experiment; only then will they turn to the tumbler under which the coin is hidden.

Let us now weaken the influence of the visual signal. We repeat the first experiment, but impose a short, 10-second delay between the hiding of the coin under the cup and the execution of the movement. This forces the child to act according to the *traces* of the visual signal whose effectiveness we are considering. The majority of children in the younger group successfully execute this task; only a few, the very youngest, cease to subordinate their actions to the visual instruction and begin to grasp both objects, losing track of the task of finding the coin that is hidden under one of them.

However, we again modify the conditions and after repeating the experiment three or four times with the cup and the 10-second delay we hide the coin under the tumbler located on the right, all within sight of the child. The picture now changes substantially. The ten-second delay turns out to be sufficient for the visual signal to yield its place to the decisive influence of the reinforced motor habit. The overwhelming majority of children now repeat the movement directed toward the cup on the left, ceasing to be directed by the image of the coin hidden under the tumbler on the right.

This orienting, directive influence of the visual signal is maintained better among children of the older group (1;8 to 2;0). Even when the execution of the movement is delayed, they solve the task well, directing their search to the object under which they saw the coin being hidden.

This means that the orienting, directive role of the visual image becomes so effective at the end of the second year of life that the child submits to it completely, and successfully overcomes the inertia of the motor connections which have arisen.

A completely different picture appears in those cases where we replace the immediate, visual signals by verbal ones. For this purpose we again place before the child the two above-mentioned objects, a cup and a tumbler, but this time unseen by the child, we slip the coin under the left-hand cup. In order to orient, i.e. to direct the actions of the child, we now draw upon a word rather than a visual image. We tell the child: "The coin is under the cup . . . Find the coin!" This instruction attunes the child completely and the game continues, but its results turn out to be profoundly different. While the trace of an immediate visual impression caused all children of the younger group to reach with assurance for the cup under which they saw the coin being hidden, the verbal instruction turns out to be wholly insufficient for this directive role: a considerable proportion of the children of this age lose track of the task and begin to grasp *both* objects before them. When we repeated the experiment with a ten-second delay in the execution of the action, this loss of directed activity among the children of the younger group was almost universal.

We then returned to the experiments with the immediate (non-delayed) execution of the action. When we reinforced the required reaction by repeating the instructions several times, "The coin is under the cup . . . Find the coin!", the children of the younger group turned out to be capable of executing it in an organized way: the word achieved the required directive function, and the children reached for the object named. However, if we altered the verbal instruction and, without changing the intonation, said, "Now the coin is under the tumbler . . . Find it!", only an insignificant proportion of the children changed their movements, while the great majority repeated their previous movement. When a ten-second delay was imposed on the execution of the task, all the children of the younger group failed to let their action follow the changed verbal instruction; they continued to execute the stereotyped movement that had been reinforced in the previous experiment and, as before, turned to the cup on the left.

The children of the older group (1;8 to 2 years), who solved these tasks with uniform success when the directive role was played by a visual signal (in experiments with delayed as well as with immediate execution), turned out to lag behind when they had to execute the task according to verbal instructions. They did carry out both tasks well if they were allowed to make the necessary movement immediately; then they would turn to the cup after the instruction "The coin is under the cup . . . Find the coin!" and to the tumbler if the instruction was "The coin is under the tumbler . . . Find the coin!" However, it was enough to delay the execution of the instructions by ten seconds for this orienting, directive role of the verbal instruction to be insufficiently effective. After three repetitions of the experiment with the instruction "The coin is under the cup . . . Find the coin!" the transition to another command—"The coin is under the tumbler . . . Find the coin!"—deprived the verbal instruction of its directive role, and the child continued inertly to execute the former habitual movement. In these cases the kinesthetic stereotype which had been worked out earlier overcame the insufficiently established effect of the word.

A comparative analysis of the orienting or directive functions of visual and verbal signals allows us to see how late the directive role of the word is formed in early childhood.

III

While the directive function of straightforward, "deictic" speech is already formed around the age of 2, the kind of speech that involves more complicated preliminary connections—connections which precede the action and organize it in advance—acquires a regulative function considerably later, and its development occupies the entire third and partly the fourth year of life.

This time let us turn to a child with a more complicated, involved instruction. "When the light flashes, you will press the ball (rubber bulb)" or ". . . you will raise your hand." Such a verbal instruction, formulated this time in a syntactically complex, "conditional" *sentence*, does not require any immediate realization of an action. It must close a preliminary verbal connection, giving to the appearance of a stimulus ("light") a conditional meaning of the signal for action ("you will press the ball"). The directive role is played here not by a separate word, but by a relation, a synthesis of words entering into a sentence; instead of an immediate, "triggering" role it acquires a preliminary, conditional, "pre-triggering" function.

It has been shown experimentally (Jakovleva 1958, Tikhomirov 1958) that the possibility of establishing such a pre-triggering system of connections on the basis of speech—not to speak of the possibility of subordinating further conditional reactions to it—is something unattainable for a child of 2 to 2½ years, and sometimes even for a 3-year old child.

The younger children of this group (1;10 to 2 years) appear unable to realize that synthesis of separate elements which is required by the instruction formulated in the sentence. Each individual word contained in the sentence evokes in the child an immediate orienting reaction, and as soon as he hears the beginning of the sentence, "When the light flashes . . .," the child begins to look for the light with its eyes; when he hears the end of the sentence—". . . you will press the ball"—he immediately presses the device in his hand. At this stage the separate words have already acquired an effective triggering function, but the creation, by means of words, of a preliminary pre-triggering system of connections, which requires the inhibition of immediate reactions and their separation into individual fragments, turns out to be unattainable. This is why the actual presentation of a light signal—the flash of light—does not at this stage lead to a conditioned movement, and evokes only an immediate orienting reaction: the child begins simply to inspect the light, which has not yet become for him a conditional signal for the pressing of the ball.

It would, however, be incorrect to believe that the formation of this more complex form of directive speech—the closing of conditional, pre-triggering connections—depends entirely on the ability to relate words which comprise a sentence, i.e. to do the work of synthesizing the elements of a sentence into a single system. Even when a child, some time later, is able to do this synthesizing work and begins to "understand" the meaning of the whole sentence well, the effective directive role of the sentence can still remain absent for a long time.

Let us adduce the experiments which demonstrate this interesting fact.

We present a child at the end of the third year of his life (2;8 to 2;10) with an instruction of this kind, and we see a picture which differs basically from the one that we have just described. A child at this age will as a rule make the required connection without particular difficulty, and when the light flashes he will press the ball; however, he will be unable to stop the movements which have been triggered by speech and he will very soon begin to press the ball regardless of the signal, continuing involuntarily to repeat the previous movements. Even the repetition of the instruction or the reinforcement of the inhibitory link which is hidden in it—even the request to "Press *only* when the light flashes" and "*Not to press* when there is no light"—all this turns out to be powerless to stop the motor excitation that has begun; on the contrary, this excitation is sometimes even *reinforced* by the inhibitory instruction, which in the given case turns out still to lack its inhibitory meaning and continues to act *non-specifically*, only strengthening the dominant motor response.

While speech at this time has already acquired an effective connection-closing triggering function, it has thus not yet acquired an effective inhibitory role.

This weakness of the inhibitory function of speech, as was shown by the observations of Tikhomirov (1958), can be seen most vividly by means of special experiments. Let us complicate the instruction described above and present it to a child of 3 to $3\frac{1}{2}$ years. We will ask it to *press* the ball every time a *red* light goes on, and *not to press it* when a *blue* light goes on; in other words, we will place the child in circumstances in which speech requires a complex *selective* reaction—positive with respect to one signal (red) and inhibitory with respect to another (blue). We let the child repeat the instruction and we are persuaded that all the information included in the sentence has reached him and is retained. Does this mean that it also possesses an effective directive role?

The experiment shows that this practical correspondence between the semantic meaning of the sentence and its directive role does not appear for a long time. Having understood the meaning of the instruction and repeating it correctly, the child is practically unable to execute it: the excitation provoked by the signal turns out to be so considerable and diffuse that after only a few attempts the blue signal, too, begins to evoke in the child impulsive motor responses. At first he attempts to control them but later, as his excitement grows while the directive function of the inhibitory verbal instruction weakens, he begins to perform the movements without any restraint.

In clashing with the inert excitation evoked by a positive signal, the inhibitory link in the verbal instruction is crushed. At first the child retains the entire instruction, but though he repeats it correctly, he is nevertheless unable to subordinate his actions to it. It is not uncommon for the inert excitation evoked by the positive part of the instruction to become so overwhelming that, under the influence of his own impulsive reaction, the child loses the inhibitory link contained in the verbal signal and begins to assure the experimenter that the instruction required him to press the ball in response to both signals presented to him.

Thus the insufficient mobility of the child's neurodynamics at first destroys the directive role of the verbal instruction, and later distorts the entire system of links contained in it.

IV

The question now arises: Can we reinforce the regulating function of verbal connections, and if so, how can this be done most effectively? The solution of this question may bring us closer to the description of certain mechanisms of the directive function of speech.

The experiments carried out by Paramonova (1956) showed that there are very simple means for heightening the directive influence of speech when the effect of the traces of a verbal instruction turn out to be insufficient.

Let us carry out an experiment of the kind already described with a 3-year old child. We ask him to press a ball in response to every *red* signal and to refrain from pressing it in response to every *blue* one. We introduce only one change into this experiment: we accompany each flash of the red light with the direct command "Press!" and every flash of the blue lamp with a similar command, "Don't press!" If such plainly directed speech is introduced, it allows the child quickly to work out a fairly effective system of selective reactions. What could not be attained through *preliminary* connections evoked by a verbal instruction turns out to be easily attainable if we draw upon the *immediate* influence of verbal commands. In direct speech, the directive function has been fairly effectively established; its influence is therefore capable of concentrating the course of nervous processes and of producing a differentiated habit.

In the experiments just described we drew upon the directive function of verbal commands in order to make more precise the influence of verbal instructions and to secure the organized course of the child's motor responses. Could we not, however, for this purpose draw upon the *child's own speech* and have it support the traces of the verbal instruction, which weaken relatively fast? After all, as L. S. Vygotskij has already shown, the function which at first is distributed between two people can easily turn into an internal psychological system, and what a child today does with help, he will tomorrow be able to do on his own. The investigation of the *directive possibilities of the child's own speech* can uncover a new and essential side of his linguistic development.

We repeat the experiment described, but introduce some substantial changes. In order to make it easier for the child to carry out his task correctly, we ask him *to give himself supplementary verbal commands*, accompanying each appearance of a red signal with the word "Press!", and the appearance of each blue signal with the words "Don't press!" Will this utilization of the child's own commands reinforce the action of the verbal instruction and strengthen its directive role?

The experiment shows that it is not so simple to obtain a directive influence from the child's own speech, and that over the first years of life the directive role of the child's own speech undergoes a complex course of development.

Let us begin with children of 2 to 2½ years and simplify our experiment for this purpose. We ask the child to respond to each flash of the red light by pressing the ball; but in order to remove those excessive movements which, as we have indicated above, are not subject to the control of an inhibitory instruction, we ask the child to accompany each motor reaction with the word "Press!" (or even with something easier to pronounce, such as "Now!", to which we assign the meaning of a self-command). The experiments of S. V. Jakovleva (1958) have shown that the active speech of a child at this age is so insufficiently developed, and the underlying neurodynamics so inert, that the child of 2 to 2½ years of age still finds difficulty in coordinating his verbal commands with the signal and frequently begins to utter excessive, stereotyped commands. It is significant that even if the child succeeds and begins to say "Press!" (or "Now!") only when the signal appears, his entire energy is diverted to the utterance of this word, and the motor reaction which is supposed to be associated with it becomes extinct. The child at this age cannot yet create a *system* of neural processes that includes both verbal and motor links, and the word does not play any directive role.

As O. K. Tikhomirov's experiments (1958) showed, it is only at 3 years of age that the neurodynamics which underlie the speech processes are sufficiently mobile for the child to time his own verbal command with the signal and for the command to exert a directive influence on the motor response as it becomes a mobile link in a unified system with it. While the child is unable to control his excessive, diffuse pressings of the ball according to the preliminary instruction, he easily achieves this control when he begins to give himself the commands "Press!" and "Don't press!" In concentrating the diffuse excitation, the child's own verbal responses, functioning on a feedback principle, here acquire their directive function.

However, is this directive function of the child's own speech fullfledged? Control experiments have answered this question in the negative and have permitted us to see more deeply into the mechanisms of the early forms of the directive function of speech.

Let us return again to the more complicated experiment described above. We present a child of 3 to 3½ years with the instruction to press a ball every time a red light flashes and to refrain from pressing it when there is a blue flash, but we give him the possibility of accompanying each red signal with his affirmative command "Press!" and every blue signal with his own inhibitory command, "Don't press!" Does the directive role of the child's *inhibitory* verbal response have the same, full value as his *positive* verbal response?

The experiments which have been conducted for this purpose have disclosed some very substantial peculiarities of the regulating effect of the child's own speech. The verbal responses "Press" and "Don't Press" turn out to have a complex structure. Physiologically they are, first of all, motor responses of the speech apparatus and are thus always connected with the positive phase of an innervation. But in virtue of their *meanings* they are systems of connections which, in the former case, have a positive, and in the latter case, an inhibitory signal value. Which side of the child's own speech—the motor ("impulsive") or semantic ("selective") side—here influences the motor processes and acquires the directive role?

The experiments of O. K. Tikhomirov yield an answer to this question. A child of 3 to 3½ years easily responds to each light signal with the required word, but in uttering the command "Don't press" in response to the blue signal, he not only fails to restrain his motor responses, but *presses the ball even harder*. Consequently, the child's own verbal reaction "Don't press" exerts its influence not in its semantic aspect, i.e. not by the selective connections which are behind it, but by its immediate "impulsive" impact. This is why the directive influence of a child's own speech at this stage still has a non-selective, non-specific character.

At least one more year must pass before the directive role goes over to the selective system of semantic connections which are behind the word, and—as Tikhomirov has observed—it is only at the age of 4 to 4½ years that the verbal response "Don't press" actually acquires the inhibitory effect specific to speech.

However, for this stage of development one circumstance is typical: as soon as the directive role passes to the semantic aspect of speech and that aspect becomes dominant, external speech becomes superfluous. The directive role is taken over by those inner connections which lie behind the word, and they now begin to display their selective effect in directing the further motor responses of the child.

The development of the pragmatic, directive aspect of speech constitutes a new chapter in psychology and psycholinguistics. It still has almost no facts to operate with that are derived from systematic investigation. However, by establishing the fact that by no means all the information carried by speech ipso facto acquires a directive value in determining human behavior, and by investigating the formation patterns of this directive role of speech, this chapter has already opened important new vistas for the scientific investigation of the organization of human behavior.

REFERENCES

Homskaja, E. D. (1958). "An Investigation of the Influence of Speech Responses on Motor Responses in Children with Cerebroasthenia" (in Russian), *ibid.*, pp. 131–259.

Jakovleva, S. V. (1958). "Conditions of Formation of the Simplest Types of Voluntary Movement in Children of Pre-School Age" (in Russian), in Luria (1958), pp. 47–71.

Kol'cova, M. M. (1958) *O formirovanii vysšej nervnoj dejatel'nosti rebënka* [On the Formation of the Child's Higher Neural Activity]. Leningrad.

Ljublinskaja, A. A. (1955). *Rol' jazyka v umstvennom razvitii rebënka* [The Role of Language in the Mental Development of the Child] (=Leningradskij Pedagogičeskij Institut im. Gercena, *Učenye zapiski*, vol. 112).

Luria, A. R. (1955). "The Role of the Word in the Formation of Temporary Connections in Man" (in Russian), *Voprosy psikhologii*, no. 1, pp. 73–86.

Luria, A. R. (1956*a*). "On the Directive Role of Speech in the Formation of Voluntary Movements" (in Russian), *Žurnal vysšej nervnoj dejatel'nosti*, vol. VI, no. 5, pp. 645–662.

Luria, A. R., ed. (1956*b*, 1958). *Problemy vysšej nervnoj dejatel'nosti rebënka* [Problems of the Higher Neural Activity of the Child], vols. I and II. Moscow.

Luria, A. R., and F. Ia. Yudovich (1958). *Reč' i razvitie psikhičeskikh processov rebënka*. Moscow. English version: *Speech and the Development of Mental Processes in the Child*. London, 1959.

Paramonova, N. P. (1956). "On the Formation of Interactions Between the Two Signal Systems in the Normal Child" (in Russian), in Luria (1956*b*), pp. 18–83.

Rozengardt-Pupko, T. L. (1948). *Reč' i razvitie vosprijatija v rannem detstve* [Speech and the Development of Perception in Early Childhood]. Moscow.

Tikhomirov, O. K. (1958). "On the Formation of Voluntary Movements in Children of Pre-School Age" (in Russian), in Luria (1958), pp. 72–130.

Vygotskij, L. S. (1934). *Myšlenie i reč'* [Thought and Language]. Moscow.

Vygotskij, L. S. (1956). *Izbrannye psikhologičeskie issledovanija* [Selected Psychological Studies]. Moscow.

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The Directive Function of Speech in Development and Dissolution

Part II: Dissolution of the Regulative Function of Speech in Pathological States of the Brain*

I

Since Hughlings Jackson, almost one hundred years ago, first called attention to the problem of the "dissolution" of speech, the pathology of speech processes has occupied an important place in clinical and psycholinguistic research. However, while the study of disturbances of the phonetic, morphological, syntactic, and semantic aspects of speech is reflected in many hundreds of publications dealing with the problems of aphasia,[1] the disturbance of the pragmatic or directive function of speech in pathological states of the brain has hardly been the object of investigation. Nevertheless, the study of such disturbances deserves to occupy a leading place in the effort to understand the "dissolution" of mental activity in pathological conditions.

In order that the system of connections that arises on the basis of speech efficiently determine further activity, it is not enough that the information carried by speech reach the subject. A number of further conditions must be fulfilled; important among them is the maintenance of the strength, the equilibrium, and the mobility of the neural processes which determine the flow of higher neural activity.

If one of these conditions is disturbed, the directive function of speech connections may suffer substantially. The system of connections which has arisen on the basis of speech may either become pathologically

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[1] We have dwelled on these problems in detail elsewhere; cf. Luria (1947, 1958*b*). References are fully identified at the end of this article.

weakened, so that its directive influence is rapidly extinguished; or it may become pathologically inert, so that the switch to a new system of connections, replacing the previous ones, is impossible; or, finally, a change in the equilibrium of stimulating and inhibiting processes, which so commonly arises in pathological states of the brain, can actually cause the directive influence of speech connections to become sharply handicapped. Can we forget those patients with a distinctly expressed neurosis in whom the conservation of information received through speech does not guarantee the conservation of that organized, "voluntary" character of behavior which is typical of normals? Consequently we have every reason to expect that pathological states of the brain which are accompanied by a disturbance in the strength of neural processes, their equilibrium, and their mobility, will produce conditions which will be patently reflected not only in the significance and communicative aspects of speech, but also in the realization of its directive function.

But there is a still more significant reason for investigating speech disturbances caused by brain pathology. Everything we know about the complex structure of the human cerebrum warrants the belief that the relation between all the aforementioned aspects of speech activity—semantic, syntactic, and pragmatic (directive)—is preserved in unequal measure in different forms of brain pathology, and we expect that the disturbances of the process of analysis of information carried by speech and of the realization of its directive influence will not always proceed in parallel. In other words, we may expect that pathological states of the brain may bring about a disturbance of *different links of that chain of processes* which enable man to obtain an adequate picture of his environment and correctly to regulate his mental activity. Hence an analysis of the changes in speech connections under pathological conditions of the brain will reveal to us new possibilities for investigating the structure and the dynamics of the directive function of speech, with which we are now concerned.

Let us pass on to the relevant facts.

II

We begin our analysis with those cases in which the directive influence of speech appears to be blocked in its executive link so that the information, which reaches the patient fully, seems to be completely incapable of determining his subsequent activity, but in which certain circumstances may completely eliminate this defect.

Over thirty years ago we had occasion to carry out a series of experiments on patients affected by Parkinson's disease.[2] In these cases, lesions in the subcortical motor centers soon make it impossible to evoke voluntary movement by verbal instructions. The injured subcortical apparatus excites repeated tonic responses, and the pathologically perseverating tension of all muscles is an obstacle to the execution of the instruction. It is easy to imagine such a difficulty in carrying out a voluntary movement if one briefly tenses all the muscles of one hand and then tries to move it without relaxing the tension.

However, the difference in the cases of Parkinsonism lies in the fact that the cortical motor apparatus remains fully intact. Consequently, if the center of gravity of the motor act is shifted to *cortical mechanisms* and the influence of subcortical components is thus removed, or at least diminished, it is again possible for the patient to execute the movement. And it is for this reason that a patient with Parkinson's syndrome who is unable to execute extended automatic movement dependent on subcortical mechanisms, easily carries out movements in response to external conventional signals which are effected at the cortical level.

This can be demonstrated by means of a simple experiment. A patient is asked to beat a simple rhythm with his finger. After 20 to 30 seconds his movements will begin to be extinguished, the general tension of the muscles will rise sharply, and the movement will stop. The patient is then asked to beat his finger in response to the verbal signals, "Now! Now!" This task, which is dependent on the cortical level of regulation, is completely accessible to him, and the movement can be continued for some time. Next, the patient's movement is tied even more closely to his speech system by attaching a symbolic function to his movements. He is asked to reply to the experimenter's questions by beating out the necessary numbers with his finger. If we then ask him, "How many wheels on a car?" or "How many points on a compass?" we see that the same patient who had failed in the previous experiment and could not automatically strike the table with his fingers even two or three times, easily begins to do so, switching his movements into his speech system and subordinating them to the complex dynamic constellation of cortical connections.

It is hardly necessary to emphasize how distinctively the preserved directive function of speech connections is thus brought out. This function overcomes the inertia of neural processes which arose as a result of injury to the subcortical motor apparatus.

The discovery of this phenomenon served as the beginning of a whole series of investigations concerning the functional compensation for

[2] The data of these experiments were first published in our book, *The Nature of Human Conflicts* (Luria 1932).

defects arising from brain injuries.[3] But the experiment may not seem convincing enough. After all, it may be objected, the lesion is here restricted to *subcortical* connections, while the cortex is completely intact. Can the directive function of speech be maintained in cases where the *cortex itself* is in a pathological state?

This question is answered by a series of experiments conducted by E. D. Homskaja (1956, 1958), nearly thirty years after the above-mentioned observations had been made.

The cerebro-asthenic syndrome is clinically well known. After an infectious illness or a trauma to the brain, the cortex frequently passes into a pathological state characterized by stimulational weakness. The strength of neural processes appears to be weakened, and the equilibrium of the basic neural processes is affected. Particularly severe is the impairment of the most complex processes of active inhibition; every frustration, no matter how small, is manifested in the diffusion of an excited, irritated state. Educators in children's clinics and in special schools are familiar with children who react with excitement to every difficulty and are unable to refrain from excessive agitated movements even when the teacher asks them to control themselves.

What has been said is enough to warrant the assumption that in these children the directive function of speech traces is impaired; the information of the prohibitory command of the teacher is fully perceived by them, but it does not achieve the required effect.

Let us follow this weakening of the directive function of speech traces in special experiments. A cerebro-asthenic child, seated before a signal device, is given a rubber bulb and is asked to press the bulb at every flash of a *red* light and to refrain from pressing it at every flash of a *blue* light.[4] If these signals are presented slowly, with relatively substantial intervals between them, the child of 9 to 12 years can carry out the task without difficulty and without error. However, if the signals are made shorter and the intervals between them are reduced so that the flashes come at a rapid pace, the situation changes radically. Then the child, though he remembers well what he is supposed to do, turns out to be incapable of carrying out his task, and in response to the rapidly presented blue (inhibitory) signal he impulsively presses the bulb, often accompanying these excessive pressings with a delayed reaction, "Oops!" or with the exclamation, "Wrong again! . . ." The inhibitory processes in the cortex of such a child are so weak, and the excitatory ones so easily diffused, that

[3] Luria (1948). An English translation is in preparation.

[4] The procedure of such an experiment was described in detail in Part I of this article; see *Word* XV (1959), 348.

the traces of the verbal instruction cannot overcome the pathological state of the child's neurodynamics and adequately direct his behavior. Consequently, the directive function of the verbal traces is substantially impaired in such children.

But can we not strengthen this directive function in some way and thus compensate for the defects of the child's neurodynamics?

Let us return to the experiments which we have already described,[5] tracing the evolution of the directive function of speech. We replace the motor response to the red signal by a verbal response, "(Press) now!" and we ask the child to reply to every blue (inhibitory) signal with the words "Don't (press)!"

The verbal responses of a child with the cerebro-asthenic syndrome suffer from the impairment of his neurodynamics considerably less than do his motor processes. Therefore a child who responds with many impulsive movements is able to avoid giving incorrect, impulsive, *verbal* responses completely. Could we not utilize this fact in order to compensate the defects of his motor processes by means of his own speech?

For this purpose, the motor and verbal responses of the child may be united. The child is asked, at the appearance of every *red* flash, to say "Press!" and to press the bulb, but at the appearance of every *blue* flash to say "Don't!" and to refrain from pressing it. These experiments, conducted by E. D. Homskaja, showed to what degree the *immediate* directive influence of loud speech is intact in these children. When the verbal and motor responses were unified, it became evident that *the child's own verbal commands were directing his motor responses,* and in these "unified" experiments the impulsive motor reactions to inhibitory signals disappeared almost completely. The directive function was here characteristically played not by the innervation of the verbal reaction itself, but by that system of selective connections which stand behind the word. When Homskaja replaced the child's own selective commands, "Press!" and "Don't press!", by monotonous repetition of "I see! I see!" at the appearance of every signal, no directive influence of speech on the flow of motor reaction was obtained. The external speech activity of the child, intact in its neurodynamic peculiarities and in its complex semantic structure, retained its directive function as well, and it was this circumstance that made it possible to draw upon the child's own speech as a means of compensating for the defects in its behavior.

III

But there are also cases of pathological brain states in which a massive impairment of neurodynamic processes affects the speech system as well,

[5] *Word* XV (1959), 349.

and the directive role of speech then becomes deeply impaired. The strength, equilibrium, and particularly the mobility of neural processes in these cases turn out to be pathologically altered to such an extent that the normal flow of the speech processes themselves, and the normal organization of the connections which are based on them, are profoundly disturbed.

One set of instances can be found in connection with oligophrenia. The form of deep mental retardation bearing this label develops as a rule after inflammation, intoxication, or trauma affecting the child's brain even at the fetal stage, at the time of birth, or in very early childhood.

The profound retardation of such children is manifested in the entire organization of their complex neural activity, but as was shown in special investigations (Lubovskij, 1956; Meščerjakov, 1956, 1958; Pevzner, 1956; and others), the damage is greatest in those forms of neural organization which are the basis of speech activity or which are achieved by means of speech.

These children form complex temporary connections with difficulty, and find it especially hard to carry out those operations of abstraction and generalization which are accomplished by means of speech. Consequently the information which reaches them is greatly reduced, and its organization is simplified. A newly established connection is easily destroyed under the influence of external agents (or "noise"). However, if a system of connections does become consolidated, it becomes pathologically inert and almost incapable of being restructured (Luria, 1956, 1958*a*; Pevzner, 1956). It is particularly characteristic of these children that the dynamics of neural processes underlying speech activity are in their case impaired not less, but more than the dynamics of neural processes which are materialized in simpler sensori-motor reactions.

Can speech, under these circumstances, retain that directive function on which we drew when we wanted to compensate for the functional defects of children with cerebro-asthenic syndromes? Experiments have answered this question in the negative.

A child with oligophrenia is subjected to the experiment previously carried out to demonstrate the intactness of the directive function of speech in cerebro-asthenic children, but under somewhat modified circumstances. An oligophrenic child aged ten to twelve with a profound form of mental retardation is asked to press a bulb in response to a *red* flash and to refrain from pressing it in response to a *blue* flash. After the habit, following a certain amount of drill (of course, with the signals being slowly presented), is sufficiently well established, we try to restructure it. This time the child is asked to change the previous condition and to respond to every *blue* signal by a motor reaction, but to refrain from any movement at a *red* signal.

Experiments have shown (Lubovskij, 1956, *et al.*) that this task, so simple for a normal child (or even for the cerebro-asthenic children described above), is often beyond the powers of a child with severe oligophrenia. At first he correctly follows the new verbal instruction, but he retains it only for a short time, and if the experiment is interrupted by a brief pause or if some sharp extraneous signal is introduced, the directive influence of the new instruction is destroyed and the child begins inertly to carry out the old system of connections, pressing at *red* flashes and refraining from pressing at *blue* flashes.

Can we draw on the child's own speech in order to overcome this pathological inertia in the way we utilized it with the cerebro-asthenics? All attempts to resort to the oligophrenic child's own speech reactions have resulted in failure.

In the experiments of Lubovskij (1956), Homskaja (1956), and Marcinovskaja (1958), a child was asked to replace his motor reactions by verbal ones, replying, according to the changed verbal instructions, "Don't press!" to every *red* signal and "Press!" to every *blue* one. While the child with the cerebro-asthenic syndrome had found no difficulty in such a restructuring of verbal responses, a child with profound oligophrenia often stumbled over this task. Having learned, in the first experiment, correctly to answer "Press!" to a *red* signal, and "Don't press!" to a *blue* one, these children were unable to restructure their verbal responses afresh and obstinately retained the old pattern even under the new conditions.

The inertia of neural processes which is typical of the speech activity of these children, also produces additional difficulties. Having begun to say "Press!" and "Don't press!", our subjects would continue inertly to repeat the alternation of these two verbal responses, regardless of the signals presented to them. Here meaningful speech was replaced by a mechanical stereotype, and its complex functions had decayed.

To the question whether such inert speech, which easily turns into a mechanical stereotype, can play a directive role, experiments have also given a negative answer. A child with profound oligophrenia is handed a bulb and is asked, in unifying his motor and verbal reactions, to respond to every *blue* signal by "Press!" and at the same time to press a bulb, but at a *red* flash to say "Don't press!" and to refrain from pressing the bulb.

Marcinovskaja's observations (1958) have shown that many severe oligophrenes find this task completely unattainable. While they respond to the signal verbally, they completely cease to press the bulb; or else, reacting by a movement, they cease to respond verbally. Even if the co-ordination of speech and movement is possible for such a child, his stunted, inert speech is still unable to play a directive role. Accompanying his movements by inert verbal reactions which easily get stuck and lose their meaning, the child, instead of improving, worsens his motor reactions.

It is evident that the directive function of speech is deeply impaired in these cases.

It is interesting that in the experiments with oligophrenia, speech turns out to be dynamically affected even in its contentive, meaningful function. When, for example, in Meščerjakov's experiments (1958) an oligophrene was asked to define the meaning of words presented to him by the labels "living" and "non-living" he did this only for a relatively short time, and as soon as the experimenter twice repeated the alternation of these terms ("living—not living, living—not living"), the child's further effort at classifying the named objects decayed into an inertly alternating repetition of these two responses. The profound impairment of the dynamics of neural processes—and particularly of their mobility—deprives the word of its significative as well as of its directive role.

It is apparent how different this form of brain pathology is from that described above and how profoundly the speech processes may suffer when their neurodynamic basis is affected.

IV

The two illustrations just adduced have shown that pathological states of the brain may bring about an impairment of the verbal system of connections in various of its links, and that while in some cases the directive function of speech may remain relatively intact, in others it is grossly affected.

In both illustrations presented so far we were dealing with the general disturbance of cortical function—though unequal, to be sure, in type and extent.

But might we not take one further step and attempt to discover whether the several divisions and zones of the cortex have a differential connection with the directive role of speech process? May we not expect that injury to some parts of the cortex might produce a substantial impairment in the reception of information carried by speech, while the injury to other sectors will affect the speech process in other links, leaving the reception of speech messages relatively intact, but causing a disturbance of its directive function? Every discovery in this domain would be significant for the further analysis of the structure of speech processes and for the investigation of their underlying cerebral mechanisms.

Elsewhere (Luria 1947, *et al.*) we have already discussed the fact that a lesion of limited areas of the cortex may cause the subject to be incapable of controlling the phonetic, lexical, and logical-grammatical code of his language. The role played in this process by the temporal regions of the cortex, with their function of auditory analysis, and the parieto-occipital region of the cortex, which makes it possible to realize simultaneous syntheses (basically spatial ones), is well known.

Do all these lesions at the same time produce an impairment of the directive function of speech, or can we find cases in which the phonetic, lexical, and logical-grammatical structure of speech is preserved while its directive role is impaired?

We are still at the very beginning of this investigation, but the facts obtained so far already suggest a basis for an answer to this question.

Lesions in those sections of the cortex which reflect and elaborate exteroceptive information or, to use a label of I. P. Pavlov's, the cortical sections of the analyzers of the external world, inevitably produce an impairment in the perception of whole visual-spatial or auditory structures and make far more difficult the deciphering of those complex phonetic, lexical, and sometimes even logical-grammatical codes on which human speech is based. However, while they affect the phasic or semantic aspects of speech, they do not necessarily disturb its directive role.

We have had the opportunity to observe many scores of patients whose analysis and synthesis of visual images was disturbed, who recognized visually presented complex objects with difficulty, and for whom visual information was so reduced that they could simultaneously perceive only one visual unit. However, they carried out a process of organized search, pursuing individual fragments, directing their activity to the task which had been verbally formulated for them—and, collecting the pieces of visual information thus obtained into a system of meaningful connections secured by speech, they compensated for the defects of their receptor apparatus.[6]

We have had the opportunity, too, to observe numerous cases in which the impairment of the analysis and synthesis of the phonemic structure of language resulting from lesions in the temporal regions of the cortex, deprives the patient of his ability to perceive speech addressed to him, but by shifting to an analysis of speech sounds with the support of a

[6] A case of this type is analyzed in detail in our article on the mechanisms of visual perception in persons with lesions in the occipito-parietal areas of the brain, to appear in *Brain* in 1959.

visually perceived oral image, the patients were able to perform this task and to compensate for their defects to a certain extent.

We have observed a great number of cases in which, as a result of lesions in the parieto-temporal cortex the patient was unable to synthesize the signals into one structural whole and to grasp complex logical-grammatical constructions; but such patients successfully replaced their impaired simultaneous synthesis by consistent consecutive syntheses of separate elements of information being put in. With the support of auxiliary means, such patients effected the reception of this information by other, roundabout ways.

In all these cases[7] the impairment connected with the input of information was successfully compensated for by the intact state of more complex and higher levels. It is enough to see the perseverance with which patients of this type carry out their tasks and work on themselves, to realize that the directive function of those neural connections which have arisen on the basis of speech is preserved in them.

Analogous facts could be observed in those patients who had lesions in the regions of the cortex related to effector processes, i.e. to the output of speech.

We have had numerous occasions to observe patients in whom lesions in the premotor zone of the cortex produced complete inability to form a well automatized motor habit, and who, for example, were unable to beat out a rhythm such as – – · · · – – – · · · However, if we added speech to the implementation of this task and asked the patient to dictate to himself, "One, two—one, two, three" or to say to himself, "Strong, strong, weak, weak, weak," or even to give himself auxiliary symbolic support by means of speech (one such patient imagined a row consisting of two large cannon and three small machine guns), the task, based on the system of directive connections arising on the basis of speech, was successfully achieved.[8]

In all these cases, lesions in specific areas of the brain bring about a noticeable impairment in the analysis and synthesis of visual, auditory, or proprioceptive signals, and sometimes cause severe defects in the decoding of speech, but they do not affect the directive function of speech.

There arises the question as to whether there are also opposite cases, in which the external organization of speech codes remains intact while the directive function of speech is affected. This problem was thoroughly analyzed in our laboratory. Despite the fact that these investigations are still in their infancy, there are already enough facts at our disposal to suggest that this type of dissociation is indeed possible.

[7] Analyzed in detail in Luria (1947, 1948).

[8] See also Luria (1948).

According to the investigations of N. A. Filippyčeva (1952), B. G. Spirin (1951), A. I. Meščerjakov (1953), M. P. Ivanova (1953), and others, this type of impairment in the directive function of speech may occur when there are extensive lesions in the frontal zone of the cortex.

In experiments resembling those to which we have repeatedly referred, a patient with massive injuries to the frontal lobe is asked to press a rubber bulb in response to every *red* flash and to refrain from pressing it in response to every *green* flash. (In a variant experiment by E. D. Homskaja, still unpublished, the instruction called for *strong* pressure on red signals and *weak* pressure on blue signals.) It was apparent that this is a task of great difficulty. The inertia of excitations in the motor analyzer is so severe that movements, as soon as they are established, turn into stereotypes, and the patient begins alternately to press and to refrain from pressing—or to press the bulb with equal force—although he remains perfectly aware of the verbal instruction. The influence of connections set up by this verbal instruction turns out in their case to be too weak to counterbalance the stagnant processes in the cerebral apparatus that produces movements; the directive role of the connections is easily extinguished.

It is important to note that, as Homskaja showed, the inclusion of the patient's own active speech, so effective in the case of cerebral asthenia, is not only futile for the frontal patients, but occasionally even aggravates their performance. The speech of such a patient, falling under the influence of a pathological inertia and linked to his motor behavior with inadequate effectiveness, easily loses its directive function and is unable to compensate for the behavioral gap.

It is for these reasons that the recovery of function is so difficult for patients with massive frontal-lobe injuries, and it is for this reason, too, that frontal-lobe lesions cause damage to the structure of human behavior which is so profound and so hard to reverse.

This concludes our survey of the facts at our disposal that bear on that "dissolution" of speech of which Hughlings Jackson spoke and on the disturbance of its directive function, which interested us in particular. The analysis of the manner in which this important aspect of speech processes is formed and disturbed is still at its very beginning. However, there is already no doubt that the study of the directive function of speech in its development and dissolution represents an important chapter in psychology and psycholinguistics, and that further work in this field will contribute many new facts concerning the laws governing the workings of human speech.

REFERENCES

FILIPPYČEVA, N. A. (1952). *Inertnost' vysšykh korkovykh processov pri lokal'nykh poraženijakh bol'šykh polušarij mozga* [The Inertia of Higher Cortical Processes in Local Lesions of the Major Hemispheres of the Brain]. Dissertation, USSR Academy of Medical Sciences, Moscow.

HOMSKAJA, E. D. (1956*a*). "On the Problem of the Role of Speech in the Compensation of Motor Reactions" (in Russian), in LURIA (1956), pp. 284–309.

HOMSKAJA, E. D. (1956*b*). "On the Pathology of the Interaction of Signal Systems in Mentally Retarded Children" (in Russian), *ibid.*, pp. 310–316.

HOMSKAJA, E. D. (1958). "An Investigation of Verbal Reactions to Motor Ones in Children With Cerebro-Asthenia" (in Russian), in LURIA (1958*a*), pp. 131–249.

IVANOVA, M. P. (1953). *Narušenie vzaimodejstvija dvukh signal'nykh sistem v formirovanii složnykh dvigatel'nykh reakcij pri poraženijakh mozga* [Disturbances of the Interaction of the Two Signal Systems in the Formation of Complex Motor Reactions in Cases of Brain Lesions], Dissertation, Department of Psychology, Moscow University.

LUBOVSKIJ, V. I. (1956). "Some Peculiarities of Higher Neural Activity of Normal and Abnormal Children" (in Russian), in LURIA (1956), pp. 129–196.

LURIA, A. R. (1932). *The Nature of Human Conflicts*. New York.

LURIA, A. R. (1947). *Travmatičeskaja afazija* [Traumatic Aphasia]. Moscow.

LURIA, A. R. (1948). *Vosstanovlenie funkcij mozga posle voennoj travmy* [Recovery of Brain Functions After War Trauma]. Moscow.

LURIA, A. R., ed. (1956, 1958*a*). *Problemy vyssej nervnoj dejatel'nosti normal'nogo i anomal'nogo rebënka* [Problems of the Higher Neural Activity of the Normal and Abnormal Child], vols. I and II. Moscow.

LURIA, A. R. (1958*b*). "Brain Disorders and Language Analysis," *Language and Speech* I, pp. 14–34.

MARCINOVSKAJA, E. N. (1958). "Disturbance of the Directive Role of Speech in Severely Retarded Children" (in Russian), in LURIA (1958*a*), pp. 267–295.

MEŠČERJAKOV, A. I. (1953). *Narušenie vzaimodejstvija dvukh signal'nykh sistem v formirovanii prostykh dvigatel'nykh reakcij pri lokal'nykh poraženijakh mozga* [Disturbance of the Interaction of the Two Signal Systems in the Formation of Simple Motor Reactions in Cases of Brain Lesions], Dissertation, Department of Psychology, Moscow University.

MEŠČERJAKOV, A. I. (1958). "The Mechanisms of Abstraction and Generalization Processes in Mentally Retarded Children" (in Russian), in LURIA (1958*a*), pp. 295–389.

PEVZNER, M. S. (1956). "Clinical Characterization of the Basic Variants of Defects in Oligophrenia" (in Russian), in LURIA (1956), pp. 354–400.

SPIRIN, B. G. (1951). *Narušenie podvižnosti nervnykh processov posle operacij na golovnom mozgu* [Disturbance of the Mobility of Neural Processes Following Brain Surgery]. Dissertation, USSR Academy of Medical Sciences, Moscow.

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