The regulating role of speech. A cognitivist approach

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Abstract. This paper reexamines some theoretical and methodological questions relative to LURIA's concept on the regulating role of speech. Five main points are demonstrated: (1) VYGOTSKY's stage concept lacks the functional invariants of the subject's activity, which determine the developmental course characteristic of PIAGET's stages; (2) LURIA's methodology remains partly obscure in spite of Wozniak's recent review of this topic; (3) silent control conditions indicate that children succeed on tasks without accompanying speech, hence the attribution of regulation to speech is unfounded; (4) difficulties in coordination between a vocal and manual response explain the results more adequately than the concept of inhibition; (5) LURIA's concept of language neglects the syntactic aspect; however, it includes aspects of general intelligence which a theory such as PIAGET's can separate from language.

LURIA's work on development of regulation of behavior can be considered as an attempt to verify or to illustrate VYGOTSKY's theoretical position on the development of language and thinking. According to VYGOTSKY's basic idea, the infant acquires new functional systems through the type of relations he has with the adult world, that is, principally through language, the cultural mediator par excellence. This acquisition proceeds in stepwise fashion, and three principal stages can be distinguished.

At first, language is exclusively a means of communication with adults; it is external in its form and function. Subsequently, while keeping an external

Key Words

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form, it also acquires an internal function and becomes 'egocentric'. Finally, language becomes completely internalized in the form of verbal thinking. This developmental progression can be applied to all mental functions, particularly also to the regulation of motor behavior which is progressively controlled by internal language.

The following discussion addresses the essential problem whether the facts observed by Luria and his followers are in accord with Vygotsky's theory. This paper is therefore a methodological and theoretical analysis of research done in this field; on one hand, the problem of the experimental method's appropriateness is raised; on the other, a different interpretational framework for the various results is suggested. Since this attempt is in part similar to the paper by Wozniak [1972], it seems suitable first to discuss some theoretical points he has mentioned.

According to Wozniak, Luria looks upon the process of developing voluntary actions as a sequence of stages which correspond more or less to those of Vygotsky. While it is legitimate to impose an organization in stages on the empirical facts of Luria, it seems that these stages are to be differently understood from those of Piaget. For Piaget, cognitive development from its most elementary level of sensorimotor intelligence to its most developed forms of formal thinking proceeds in a continual manner, due to the active processes of assimilation and accommodation. Within this continuum these active processes of adaptation are true functional invariants, whereas the stages are characterized by a certain structural stability. The adaptive processes lead to certain elements of knowledge that become organized into increasingly complex structures. These structures tend by an internal logical necessity towards equilibration or closure, which are the characteristic criteria for the Piagetian stages.

For Luria, as for Vygotsky, the nature of stages is fundamentally different. First, there are really only two stages for them—one in which language has an exclusive social function, and the other where, in addition, it organizes thinking. Between these two stages there is an intermediate stage which Vygotsky calls egocentric and Luria asemantic. Moreover, the transition from stage one to stage two 'changes the nature of development radically' [Vygotsky, 1962, p. 51]. There is therefore not a continuum, as with Piaget, but rather the absence of a functional invariance and of truly active processes of the subject. Although for Soviet psychology thought develops through internalization of activities and social exchanges, the instruments or modes of these exchanges are actually present for the infant from birth; he merely has to 'discover' progressively the complex system of semantic relations given within the language. The entire cognitive development of the sensorimotor period turns out to be practically useless from the moment the child acquires language; for now it is language that takes charge of further development and changes radically the nature of this development.

Consequently, reference to Piaget's theory in order to illustrate the underlying theory of Luria appears to be out of place. For Piaget, acquisition of the symbolic function is a direct outcome of preceding sensorimotor development, and acquisition of the first linguistic structures goes hand in hand with, and is at least partly dependent on, cognitive development in general.

It also seems appropriate to discuss briefly here what Luria understands by language. No doubt for historical reasons (Pavlov) language is considered essentially as a system of words. In this view, words are at first simple physical characteristics of objects which, like other characteristics such as color or form, can become conditioned stimuli. Subsequently they 'become differentiated and generalized' as the second signalling system. This is conceived as a system of primarily semantic connections and interrelations. Recent research [Panandroulo, in preparation] indicates in fact that the word is first considered as an indissociable characteristic of the object; but this refers to the metalinguistic attitude of the child vis-à-vis the words and the language he uses. The word is therefore an indistinct characteristic of the object only in the consciousness, that is, in the reflected attitude of the subject. This situation is not true as far as the practical use of the word is concerned. From the acquisition of the semiotic function onward (around 18 months of age) words are used as holophrases, that is, they express a total situation, a relation between objects rather than a simple characteristic of these objects. Subsequently, after two years of age when two-word sentences appear, these relations become more complex. More and more complex grammatical structures are used parallel with the general development of cognitive structures. As soon as words are used as semiotic elements, the interaction between child and words is totally different from that between child and objects with their physical characteristics. Moreover, while one part of linguistic development is a process of lexical differentiation and generalization, the most characteristic aspect of language is above all the development of syntactic structures.

Surprisingly, Soviet theory, with its emphasis on the role of language and development, neglects almost totally the syntactical aspect of language and retains primarily its semantic aspect. For example, for Vygotsky, when
language controls thinking, its syntactic characteristics disappear; internal language comes about by a type of 'syntactic pruning' [VYGOTSKY, 1962, p. 139].

More recent research in linguistics, including research in the USSR [SAUMUIN, 1969], demonstrates the fundamental importance of syntax. Syntax in its most general formulation has universal characteristics and in its particular forms has social and conventional aspects through which it can become a particularly appropriate instrument of sociogenesis as envisaged by VYGOTSKY.

WOZNIAK [1972, p. 14] expressed his principal point in the following manner. 'The lack of success met with by SHELTON and FLAVELL [1970], WILDER [1969] and JARVIS [1968] in attempting to replicate the Soviet research may be traced, regardless of the actual status of verbal regulation, to inappropriate methodology deriving from a misinterpretation of the nature of the phenomena which LURIA and his coworkers have described.' The use of different experimental methods can indeed be invoked to explain the obtaining of different results; however, it seems difficult to accept that theoretical interpretation of the phenomena could lead to different experimental data. LURIA's [1961] own description of his method as well as of his results is rather imprecise, as has been noted by various researchers who faced the problem of replication. There are no clear indications on the experimental procedure, on the experimental measures, the number of subjects, control conditions, etc. One could have therefore expected that WOZNIAK would provide a detailed description of the experimental methods used by LURIA in his experiments. In fact, before indicating how the Western researchers differ in method, WOZNIAK should have detailed the method of LURIA. However, WOZNIAK gives only a summary of empirical findings without clarifying the many methodological imprecisions of LURIA, and then he proceeds to criticize Western replications on the basis that the method 'was not wholly in the spirit of the Soviet research [1972, p. 43]. This seems a curious way of criticizing. One can justifiably criticize a replication by referring to the original method but not by referring to the spirit in which the original research is presumed to have taken place.

Results Obtained by Luria

This is a short summary of the results reported by LURIA where I shall purposely emphasize obscure points.

Stage 1 (approximately from 1½ to 3 years). For infants from 18 to 24 months, the language of the adult can have a function of initiating an action but not of inhibiting an action that has already started. If one gives a rubber balloon to the infant and asks him to squeeze it, he will do so, but if one asks him to stop this action ('don't squeeze, stop') the action will be intensified rather than inhibited. The moment when the mechanism of inhibition through language becomes functional is not clear. It presumably appears at a later stage.

At this age, what can be called the coordination of a motor response and a visual stimulus is not yet possible either. The infant gives an immediate orienting response to the words 'when you see the light' and squeezes the balloon in response to the words 'squeeze the balloon' even though no light has yet appeared. After a long period of training, it is said that this coordination is possible but in that case 'constant tactile stimulation leads to a perseveration of the motor response'. The suppression of this response perseveration can be achieved by procedures of nonverbal inhibition (nonvocalized paradigms).

Stage 2 (approximately from 3 to 4½ years). This stage according to WOZNIAK [1972, p. 17] is characterized by the 'transfer of the inhibitory function from non-verbal signals to the child's own external speech'. Beginning at about 3 years, it is no longer necessary to give a preliminary training so that the child responds correctly to instructions such as 'when you see the light squeeze the balloon'. However, the infant continues to respond to the tactile stimulations of his hand and therefore gives perseverative responses. These responses can be inhibited if one instructs the child to say 'go' in response to each light stimulus and to squeeze the balloon at the same time (discrete vocalization paradigm). In this case the language of the child has a secondary effect, namely to suppress the dependence of the motor response on the characteristics of the light stimulus [LURIA, 1961].

The experiments discussed so far seem to deal with two types of phenomena. On one hand, initiation (18–24 months) and inhibition (uncertain onset) is achieved by verbal intervention of the adult through the semantic aspect of the language ('squeeze' and 'don't squeeze'). Through a similar intervention the simple coordination of a motor response to a visual stimulus is also achieved from 3 years onward. On the other hand, there are also intermediate responses due to the constant stimulation of the rubber on the palm of the hand. At stage 1, these perseverative responses are inhibited by means of nonvocalized paradigms, that is, by asking the child to remove his
hand from the balloon in order to do something else or by teaching him that the motor response suppresses the visual stimulus and consequently becomes functionally useless. At stage 2, this inhibition can be accomplished by a simultaneous vocal emission of the child (discrete vocalization paradigm).

Within the perspective of Vygotsky's sociogenesis it is important to underline that the semantic inhibition by means of the adult's language appears to have no genetic connection with inhibition of perseverating responses due to the language of the child. To what extent can one speak of a transfer of the functional inhibition from the nonvocalized paradigm of stage 1 to the discrete vocalization paradigm of stage 2? There seems to be as much difference between the two paradigms used at stage 1 as between those of stage 1 and stage 2; moreover, the two paradigms of stage 1 remain effective at stage 2 at least as much as the discrete vocalization paradigm. The two nonvocalized paradigms functioned before 3 years while the verbal paradigm does so only after 3 years; yet this fact does not seem to justify the assertion that there is a transfer of function from the nonverbal to the verbal domain. Indeed there is no good reason to think that the three processes that are called 'inhibition' are developmentally related. Finally, what do the persevering responses signify in the motor development of the child? Wozniak [1972, p. 17] holds that the inability of the 3-year-old child to succeed on the relatively simple task ('When you see the light, squeeze the balloon') is due to the fact that the child responds to 'certain other compelling classes of nonverbal signals, such as tactile stimulation of the palm'. Is this a general characteristic of motor development, a phenomenon that can be found in other situations, or is it a particular characteristic of the material used? One cannot construct a general theory about the regulating role of speech if these 'compelling classes of nonverbal signals' do not generally occur and disturb successful accomplishment of such tasks. It seems that one is dealing here with a highly specific effect due to use of a rubber balloon.

Luria's two other experiments with children of stage 2 give rise to other types of problems. In the first experiment, the child is asked to squeeze twice in response to the visual stimuli. This type of task is somewhat more complex, and children between 3 and 4 years of age fail on it with simple verbal instructions. The precise age of success is not known. If, however, the child accompanies his motor response by the words 'go, go' (double discrete vocalization paradigm), he succeeds on this task from 3 to 4 years onward. According to Wozniak [1972, p. 26], the active mechanism here, as in the discrete vocalization paradigm, is an inhibition which comes about 'between the responses and after the second response'. This interpretation and its implications will be discussed later on; in any case it seems contrary to Luria's description. According to Luria [1961], when one gives the child the verbal instruction, he succeeds on 2 or 3 trials, but afterwards he squeezes 3, 4, or more times. Thus, the child first gives two distinct responses correctly, but afterwards he fails to limit himself to this number and gives 3 or more distinct responses. In that case, regulation of the motor response limits the number of distinct responses, which is something different from what happened in the previous experiment discussed above where suppression of the response beyond the stimulus duration was required.

In the second experiment, light stimuli of different colors (for example, red and blue) are varied in random order, and the child is asked to squeeze when he sees a red light and not to squeeze when there is a blue light. In this condition, without any speech, children of 3–4 years of age give 42% responses to the negative stimulus. If the children are asked to say 'squeeze' for the positive stimulus and 'don't squeeze' for the negative stimulus (discriminative vocalization paradigm), incorrect responses to the negative stimulus increase to 70%. If, however, one asks them to say 'squeeze' to each positive stimulus and at the same time to squeeze the balloon while saying and doing nothing in response to the negative stimulus, the number of incorrect responses falls back to 35% [Luria, 1961]. The results of this third experimental condition (positive discriminative vocalization paradigm) is clearly similar – at least as far as the negative stimulus is concerned – to the result in the silent condition. It is therefore hard to understand how Wozniak can refer to a 'conflict resolution' due to the intervention of speech. The data supplied by Luria indicate that the verbal response 'don't squeeze' interferes with a differentiation which has come about relatively early without speech. This is confirmed by Wozniak who indicates that 'instructing the child to respond to the negative stimulus with "don't press" induces disinhibition'. Disinhibition of what? Obviously, the inhibition which already has been established without speech on the child's part by the mere instruction of the task.

Stage 3 (approximately from 4½ to 5½). Surprisingly, this third stage which is critical in the perspective of Vygotsky's sociogenesis has been described by Luria as by Wozniak in a more theoretical than experimental manner. It is characterized primarily by a new transfer of the regulatory function of language 'from the impulsive side of speech to the analytic
system of elected connections which are produced by speech... and... from the external to the internal speech of the child' [LURIA, 1961, p. 92]. During that period, the child given the instructions of the task can succeed very well on such complex tasks as differentiation, and he can regulate his behavior by this significative aspect of the external language ('I'll squeeze twice' in the double response task).

Accordingly, during this period and not earlier, the child should succeed in regulating his behavior by an internalized rule which the instruction had furnished. However, if one merely takes the differentiation experiment into account, the facts presented by LURIA do not justify the assertion that a rule was not internalized before stage 3, nor that this internalization implies a true semantic comprehension of the rule. Finally, as for the semantic effect of the external verbal response of the 'I-shall-squeeze-twice' type, this is not demonstrated unless at the same period the instruction alone would not produce a similar, indeed a better result. No control experiment of this type is quoted by LURIA.

A few more technical and methodological aspects of these experiments remain to be discussed. Regarding instructions, WOZNIAK asserts that they should be very simple and clear so they can be directly internalized. According to WOZNIAK, the instructions given by LURIA and his collaborators were simple and clear whereas those given by researchers in the West were extremely complicated. If one compares the instructions actually given by LURIA and those by JARVIS, one finds that they differ merely in the length and number of words. Recent experiments in psycholinguistics [FERREIRO, 1971; CLARK, 1970] indicate that the comprehension of a subordinate temporal clause of the 'When-you-see-the-light, squeeze-the-balloon' type cannot be properly understood before the age of 6 years. Therefore, LURIA's instructions cannot be called simple and clear; they are difficult to comprehend due to their grammatical structure. The instructions of JARVIS have simple imperatives coupled with explicit temporal indications ('every time the light comes on', etc.) Thus, they are longer than LURIA's instructions but they are certainly not more difficult from a linguistic point of view. Without doubt, the child well understands what is required of him, just as he generally comprehends adult orders when the context is sufficiently clear. But it is unlikely that he would internalize the instructions as a verbal rule, since he is unable to grasp the structure of that rule.

In the course of two years of experimentation, I have attempted to replicate LURIA's experimental procedures [BROCKKART, 1969; 1970]. The method of the rubber balloon turned out to be practicably impossible for children before 3 years of age. The balloon is something to scratch, to throw, to step on and possibly to squeeze. I could not use this object simply because the children would not keep it in their hands. This leads to the problem of training. It is possible that more patient experimenters than I succeeded in having the children hold the balloon in their hands long enough to observe the effects of the various instructions, but surely this could not be done without a minimal period of shaping. This would be obvious to anybody having experience in research with young infants. LURIA says nothing on this point, whereas WOZNIAK goes to the extreme of asserting that, in line with implicit Soviet theory, any previous training would confound the results. I cannot but think that such training is a necessary prerequisite for all research with young children, even if it need not be done in such a systematic fashion as was done by JARVIS.

The experimental measures of LURIA are unknown. The intervals between the stimuli should not be as short as they were in some American research (1.5 sec) because one thereby reduces the possibility of observing responses between the stimuli. On the other hand, if with LURIA one considers the instructions as a plan to be internalized in order to regulate the sequence of the subsequent action, these instructions should not be repeated at each trial. In that case, there is no need for an internalized plan but only for motor initiation. Finally, to avoid losing the attention of the child, the intervals between the stimuli should not be too long. I have therefore chosen intervals of 4-5 sec.

Another methodological problem of some importance relates to the successive order between the manual and the vocal responses. WOZNIAK [1972, p. 42] suggests that LURIA's instructions lead to a manual-vocal sequence ('The type of manual-vocal instruction reported by LURIA'), whereas the instructions of JOYNT and CAMBOURNE [1968] explicitly asked for an opposite response order, vocal-manual. WOZNIAK makes this point when he discusses whether the verbal regulation is of an inhibitive or mediative character. It seems that this discussion is far removed from the actual facts. LURIA suggests to the child 'that he says "go" in response to each flash of light and at the same time presses the balloon'. He requires therefore – theoretically – a simultaneous motor and verbal response. The instruction of JOYNT and CAMBOURNE is as follows: 'Tell yourself "squeeze" and... then squeeze the ball.' Unless one takes into account something as vague as the spirit in which these two types of instructions were given, one must notice that both instructions are similar as far as the succession is concerned. According to WOZNIAK, children from 3 to 5 years old would infer a vocal-
motor succession from the word ‘then’ in the instructions of JOYNT and CAMBOURNE, whereas they would infer simultaneity, if not a motor-verbal succession from the words ‘at the same time’ of LURIA’s instructions. However, research in psycholinguistics has demonstrated [CLARK, 1970; FERREIJO, 1971; SINCLAIR and BRONCKART, 1972] that temporal indicators are much less important for children in this particular age group than the order of the clauses. In fact, these studies indicate conclusively that the order of the action corresponds to the order of the clauses. Accordingly, LURIA’s instructions, like the instructions of American investigators, would favor a vocal-manual sequence of response, and not the manual-vocal order as asserted by WOZNIAK.

The Results of Western Investigators

From the attempts to replicate LURIA’s experiments [JARVIS, 1968; JOYNT and CAMBOURNE, 1968; WILDER, 1969; MILLER et al., 1970; BRONCKART, 1969, 1970; RONDAL, 1972] the following facts seem to emerge. Personally I confirmed the initiation aspect of the speech of the adult from around 1½ years of age. I observed in addition that the adult speech can acquire an inhibitive role from the age of 2½ onward. When the instructions for the task are the ‘When-you-see-a-red-light-squeeze’ type, I observed the following results: between 2½ and 3 years, 18% correct responses; 3 to 3½ years, 59%; 3½ to 4 years, 77%; and beyond 4 years, about 85%. These results were obtained in a condition in which the child was silent.

Clearly the majority of children can respond correctly to this type of task from about 3 years onward. JARVIS, WILDER, and particularly RONDAL have confirmed these observations. Apart from omissions, an analysis of errors shows a certain percentage of perseverative responses, but they are never as pervasive as LURIA seems to indicate: RONDAL found about 20% perseverative responses with a method and procedure that satisfies all the criteria of WOZNIAK. In this condition, the addition of a verbal response of the type ‘go’ or ‘squeeze’ could therefore hardly improve the motor response. In fact, JARVIS and BRONCKART observed no difference between the silent and the verbal condition; in the rare cases where there was a slight improvement, this was primarily due to the suppression of perseverative responses [WILDER, 1969; RONDAL, 1972].

BRONCKART and RONDAL have replicated the experiment in which the child is asked to press twice when the light appears. The results of both investigators were similar: from 3 to 4 years, 20 to 30% correct responses; from 4 to 5 years, 40 to 60%; and from 5 years onward, more than 80% correct responses. When a verbal response of the type ‘squeeze, squeeze’ (double discrete vocalization paradigm) was added, the motor response improved slightly between 3 or 3½ to 5 years of age. However, the addition of a verbal response of the ‘I-squeeze-twice’ or ‘twice’ type diminished the percentage of correct responses in comparison with the silent condition. An analysis of errors indicated that multiple-motor responses followed the verbal ‘I-squeeze-twice’ response [BRONCKART], while single responses predominated when the verbal response was ‘twice’ [RONDAL].

The discrimination experiment (‘When you see the red light, squeeze; when you see the green light, don’t squeeze’) was replicated by all investigators mentioned above. The analysis and interpretation of the results raise a number of problems because of the interference of two response systems (positive and negative) and of the general inhibition which this interference can cause. It was easy to observe this interference in the course of the experiment. It is all the more remarkable that the results of MILLER et al. [1970], BRONCKART [1969, 1970], and RONDAL [1972] show a basic agreement in spite of different procedures and materials.

In the silent condition, about 40% error to the negative stimulus was observed below the age of 4. Between 4 and 6 years of age, this percentage remained around 10 and 20%. The addition of the verbal response in the form of the ‘positive discrimination vocalization paradigm’ diminished slightly (statistically not significant) the errors to the negative stimulus [BRONCKART; RONDAL], while it had no influence for MILLER et al. The addition of the verbal response in the form of the ‘discrimination vocalization paradigm’ brought about a slight increase in errors (statistically not significant) where the verbal responses were ‘I squeeze’ for the positive stimulus and ‘I don’t squeeze’ for the negative stimulus [MILLER et al.; BRONCKART]. In the case where the verbal response to the negative stimulus was ‘no’, BRONCKART and RONDAL obtained contradictory results. Briefly, not a single investigator was able to observe the significant effect which LURIA had found for the discrimination vocalization paradigm. Nor did they observe any regulatory effect of the verbal response in its semantic aspect.

According to LURIA [1961] the regulation of motor behavior through the child’s speech is possible only after 3 years of age, because at that period the ‘neurodynamics of simple verbal reactions become more perfect than those of motor reactions’. I have undertaken [BRONCKART, 1969, 1970] a systematic verification of this thesis by asking subjects, ages 1½ to 6 years,
to give only a verbal response when the stimulus appeared. Between 1½ and 3 years no child was able to give a correct verbal response on the presentation of the stimulus. From 3 years onward nearly all children could produce a correct verbal sequence if a direct response to each stimulus was required: 'I squeeze', 'I squeeze twice', 'I squeeze, I squeeze', 'Yes', etc. In the case of the discrimination experiment, a differentiated verbal response was observed after 3½ years of age, and these results have been verified by Rondal. Perseverance in verbal responses has never been observed after 3½ years of age.

These results and effects on the motor performance, particularly the addition of a verbal response, can be explained by the fact that coordination difficulties (either visual-motor or visual-verbal) vary from one experiment to another. In the most simple experiment (one stimulus – one response) there is early coordination; from 3 years onward the majority of children succeed in this task in the silent condition. The addition of a verbal response is therefore unnecessary, except that it can suppress a few perseverative responses. When the investigator requires two motor responses at the presentation of the stimulus, success in the silent condition is not general until 5 years of age. There is a clear time-lag here in establishment of the visual-motor coordination, which accounts for the positive effect of the addition of verbal response 'squeeze, squeeze'.

In the discrimination experiments, there does not seem to be a true discrepancy between the differentiated motor response and the differentiated verbal response. No investigator has been able to observe a significant difference between the silent condition and the various vocal paradigms although Jarvis, Miller et al., and Bronckart found a slight increase of errors to the negative stimulus with the introduction of a verbal response 'I don't squeeze'.

It seems that regulation through the child's speech can only occur when visual-verbal coordination precedes visual-motor coordination. This discrepancy is a necessary condition but not a sufficient one for the verbal regulation. Moreover, up to a certain age level there must be a rhythmic similarity between the verbal and motor response. For if one asks to squeeze twice (--) by saying 'twice' (--) or 'I squeeze twice' (------), or if one asks not to squeeze (0) by saying 'no' (--) or 'I don't squeeze' (------), one practically always obtains a deterioration of the motor response. One deals here, as Luria asserts, with the impulse side of speech rather than with the semantic side. This has been confirmed by the author who in the double discrete vocalization paradigm replaced the words 'squeeze, squeeze' by 'boom, boom', or 'sing, sing', and obtained identical results.

Impulsive Aspect of Language

In his critique of non-Soviet replications, Wozniak [1972, p. 26] asserts that the term 'impulsive aspect' should not be translated conceptually as 'initiation via response-produced stimulation: ... suffice it to say that Luria does not mean to imply by this that "go" operates as a response-produced mediational stimulus of the S ---- r ---- S ---- R variety in which the vocalization must precede and initiate a motor response. Rather, from all sources ... it would seem that what is meant is that some aspects of child's vocalization, occurring after the initiation of a perseverative motor response, operates to inhibit the perseveration.'

In the absence of experimental results, the question about the different types of feedback mechanisms cannot be discussed profitably. However, Wozniak's assertion that the verbal response emitted during the motor response appears to act like a signal that interrupts the motor response and thereby inhibits perseverative responses, suggests the following remarks. His interpretation would have at least the advantage of suggesting a possible developmental link between the inhibition observed at stage 1 with non-verbal paradigms and the inhibition of stage 2 through the impulsive aspect of speech. Such a link would be important for an experimental verification of Vygotsky's theory. Unfortunately this interpretation is not really possible, for three reasons: it is contrary to several Luria texts, it can only be applied to some isolated facts, and finally, it makes it even more difficult to find a further developmental link between the impulse and the semantic aspect of speech regulation.

Luria indicates a mediative action of speech in its impulsive aspect in numerous passages. Wozniak cites Luria where he says that 'Go turns into a link between the conditioned stimulus and the reaction that controls the movement' [Luria 1961, p. 81]. This point is even clearer when Luria discusses how speech influences the dependence of the motor response on the stimulus characteristics. According to Luria, probably towards the end of stage 2, the characteristics of the motor response in the silent condition depend on the stimulus characteristics. Thus a stimulation of long duration will produce a response of long duration, whereas '... the introduction of the child's own command eliminates the direct relation between the response and the nature of the stimulus, and ... his reaction becomes subordinated to his own verbal instruction [Luria, 1961]. This formulation of Luria is not in line with an inhibition a posteriori suggested by Wozniak.
The facts observed by Luria and his Western investigators can hardly be explained as due to a mechanism of inhibition. Only Miller et al. asked explicitly that the child should speak before squeezing. With this exception, children in other experiments could infer the order of responding only from the order of the clauses in the instructions. This order was verbal-motor in all experiments, including those of Luria, whereas I gave the instructions in the following form: 'When you see the light, squeeze and say: I squeeze'. Although this formulation was the one most likely to conform to Wozniak's interpretation, it did not result in a better regulation. In the experiments where a response is required for each stimulus and where verbal responses were found to suppress perseveration in a few instances, these cases can be interpreted either as an inhibition or as a verbal initiation. The second interpretation seems more likely.

I replicated [BroncKart, 1970] the experiment 'one stimulus - one response' and varied the duration of the stimulus from 0.5 to 5 sec. In the silent condition, all children from 3 years onward responded by a squeezing response, the duration of which depended on the duration of the stimulus. If a verbal response was added ('I squeeze', discrete vocalization paradigm), the result from 3 to 4 years onward was a total or partial suppression of this dependence. From 4 to 5 years, the chief effect of speech was partial suppression; from 5 years onward, speech no longer had any effect while the original dependence remained. An analysis of the motor behavior (squeezing) indicated interesting results for the 3- to 5-year-old children. In the silent condition, the beginning and end of the responses coincided rather strictly with the beginning and end of the stimulus. When speech was introduced, a short motor response was made at the end of the stimulus and sometimes even after it. Although measurement of the stimulus and response sequence was not adequately controlled, one could nevertheless observe whether or not verbal and motor responses were simultaneous.

Therefore, the following hypothesis seems reasonable: as the verbal paradigm becomes more complex, the latency of the motor response in relation to the silent condition increases. The younger the children are, the more marked the increase. Around 3 to 4 years of age, when a double response (verbal and motor) is given, the stimulus has already disappeared, and there is no reason to prolong the motor response. From 4 to 5 years, the latency diminishes; the double response is made while the stimulus is still present and the motor response can be dependent on the stimulus. From 5 years onward, the task becomes relatively less complex for the children and, as in the silent condition, the double response is given right at the beginning of the stimulus presentation; thus the original dependence on the duration of the stimulus comes again to the fore. For Luria [1961] the dependence of the motor response on the stimulus quality was considered as an indication of nonregulation, and regulation was obtained by the introduction of speech. According to Wozniak, the verbal response should have inhibited the final part of the motor response and in this way make it independent of the stimulus. This inhibition should increase with age or at least remain stable. However, a different development seems to take place, and the reported results are hardly compatible with the hypothesis of an inhibition at the end of the response.

The hypothesis of language-inhibiting perseveration seems even more unlikely for the double discrete vocalization paradigm. According to Wozniak [1972, p. 26], '... the inhibition ... occurs both between responses and after the second response. In other words, the instruction would presumably set up each of the go's as distinct signals of the fulfillment of one response; two go's would thereby limit the child to two squeezes'. The analysis of the responses clearly indicates the following facts. In the silent condition, children, 3 to 4 years of age, gave 3-5 responses during a total duration of approximately 2 sec. In the verbal condition, these same children gave 2 responses within a duration that was rarely beyond 1 sec. Since the correct response was given in the same rhythm as incorrect responses, the single difference between these responses was the limitation to two responses in the first case. From these observations it is not easy to infer an inhibition which is supposed to function between the first and second response.

The results of the discrimination experiment also seem to be contrary to Wozniak's interpretation. According to Wozniak, "When the child (in the discriminative vocalization paradigm) says "don't squeeze" to the negative stimulus, his squeezing behavior is in Luria's own words disinhibited: he begins to squeeze" [Wozniak, 1972, p. 34]. This implies that there is a first moment in which the child gives the potential response to the stimulus: subsequently there is inhibition resulting from the instruction given by the experimenter, and finally there is inhibition of this first inhibition due to the child's saying 'don't squeeze' which then leads to the realization of the potential response. According to Wozniak [1972, p. 26], this inhibition occurs after or towards the end of the response. If this is so, how could one explain that the potential response does not appear at least partially before the effect of the first inhibition and that subsequently the second inhibition makes the response reappear? If there is a first inhibition followed by this second disinhibition, the first inhibition should become effective
before the potential response and the disinhibition before the effect of the first inhibition. In other words, it seems hardly reasonable to imagine an inhibitory mechanism which intervenes after the occurrence of the mechanism or the response it is supposed to inhibit.

The transition from stage 2 to stage 3 in Luria's theory is explained as a transfer of the regulatory role of speech from the impulse aspect to its semantic aspect. At this level, the effect of language whether in the form of an internalized rule or as a semantic accompaniment of the motor action, should take place before the action or, at most, during the action. If Wozniak is right, he would therefore have to explain, apart from the transfer from the vocal to the semantic aspect, the change from an intervention that takes place after the motor response to an intervention before the motor response.

Semantic Aspect of Language

According to Luria, this aspect of language at stage 3 has a double regulatory effect: regulation through a progressively more internalized language (internal language) and regulation through the signification (meaning) of the verbal response.

Experiments concerning internal language have shown that there is some motor activity of the speech musculature during execution of certain tasks. This activity can be specific and differentiated in the case of silent reading. For rather obvious technical reasons, empirical studies concerning the semantic or nonsemantic nature of this internal language have not been overly revealing.

However, the regulatory effect due to the meaning of verbal responses added to motor responses has never been confirmed. The reason for that is quite clear in the case of Luria's classical experiments. At the age where this semantic regulation is supposed to be effective, such tasks as discrimination or double squeezing are successfully performed in the silent condition: there is therefore no room for progress. To overcome this difficulty, Rondal [1972] chose more complex paradigms, some replicated from Luria, others devised by himself, in which general success in the silent condition was obtained not sooner than between 7 and 8 years. For example, the task would be: long stimulus - one squeeze, short stimulus - two squeezes. The addition of a verbal response with appropriate meaning did not bring about an improvement in the motor response of children 5–8 years old. On the contrary, impulse effects were clearly noted in several experiments. These results appear quite critical insofar as Rondal can hardly be considered to be prejudiced against Luria's theory: "... this regulation by the meaning aspect of the verbal accompaniment should exist; if not, this would reduce quite severely the possibilities of verbal regulation of motor behavior" [Rondal, p. 140].

Conclusions

A certain number of facts presented by Luria is clearly established: the adult's speech can initiate a simple motor act in a child from 1½ years onward, it can stop this act from 2½ years onward, and it can regulate a motor response to a visual stimulus from 3½ years onward in simple direct situations (one stimulus – one response). In more complex situations, sensorimotor difficulties are added to the difficulties of comprehending the instruction. Success on these tasks comes about between 4 and 7 years of age.

However, contrary to Luria's interpretation, in the majority of cases the task is not less well done in the silent than in the verbal condition. Among the linguistic factors that contribute to the success of a task, it seems therefore that the most important one is always the instruction given by the adult at the beginning of the task. From 1½ years onward, these instructions have a semantic influence on the behavior of the child, even if until about 6 years of age the rules of temporal subordination are not understood as such but rather inferred from the intonation, the situational context, and the order of the lexical elements.

This very important problem of the comprehension of the task by means of verbal instruction has not really been raised by Luria. Recent research in psycholinguistics [notably Brever, 1970; Slobin, 1971; Sinclair and Bronckart, 1972] has demonstrated the complexity of this comprehension and the age-related application of various strategies in decoding the instruction, all of which play an important role in Luria's experiments.

Starting from a certain level, the complexity of the task, i.e., difficulties of motor behavior, are added to the difficulties due to comprehension of the instruction. According to the Soviet hypothesis, it is at this moment that there is a change in the regulation from adult speech to verbal self-regulation on the part of the child, first under the impulse aspect of speech, then under its meaning aspect. Luria attempted to verify this change experimentally by requiring the addition of a verbal response to the motor response. This resulted in an actual increase in the complexity of the task: the child now has to furnish two forms of behaviors in response to one stimulus.
Before the age of 3½, this increase in the complexity of the task brings about a deteriorisation in the motor performance. However, in certain cases one can obtain an improvement in children between 3½ and 4½ years old which is attributed to the impulse aspect of speech; beyond 5 years no motor experiment in which acceptable controls were used has been able to give evidence of any effects due to the child’s speech in its meaning aspect.

The main problem, therefore, is that of the regulations observed between 3½ and 4½ years of age. This regulations has to do with initiation of a motor act, a rhythmic facilitation due to the motor aspects of vocalization. The hypothesis of an inhibitive effect of speech on the motor behavior of the subject is to be rejected. Instead, the explanation of the results observed can readily be found in view of competition between two motor systems, one vocal, the other manual. A temporary imbalance between these systems could bring about the dominance of one over the other. This imbalance could cause a difference in the level of awareness such that regulatory feedbacks between 3½ and 4 years of age would be better at the subcortical level (for vocal organization) than at the spinal level (for manual motor organization).

In any case, this type of regulation is hardly specific to phonetic mechanisms; any sort of reinforcement could lead to the same results. Rondal [1972] has modified the silent condition for three Luria experiments in the following manner: when the correct response was given, a small stuffed dog facing the child shook his head and barked. Under these conditions, children aged 3 to 4½ did even better than with the verbal paradigms. The vocal response of the child is therefore by no means the only instrument which can help him to overcome difficulties in sensorimotor control; it is not even a particularly apt instrument.

Moreover, this vocal but asemantic regulation can hardly be considered as lying midway between stage 1 (the influence of the adult’s speech) and stage 3 (the semantic influence of the child’s speech). According to that schema, there would be a disappearance of the semantic aspects of language at stage 2. Yet this disappearance is contrary to all that is known about the normal acquisition of language.

For a long time it has been thought that sounds emitted during the so-called phonetic period (6–12 months) are merely phonetic play, a more or less systematic exploration of possibilities in the phonetic apparatus. It now seems that certain groups of sounds, phonologic oppositions, and the rhythm of their emission already have a communicative function which is structured and universal. Ricks [1972] has demonstrated the universal functional character of four types of cries between 8 and 11 months (distress, pleasant surprise, want, contentment), and his data confirm those of Gregoire [1947] (see also Sinclair [1972]).

Before the age of 18 months, a system of communication between infants and adults is established which has a certain semantic quality. After 18 months – i.e., from the beginning of the symbolic function – all verbal interactions between adult and child are, at least partially, semantic. The phrases of the child, starting with holophrases, have for the child as well as for the adult with whom he communicates a signifying structure of meaning corresponding to a concept (signified). These semantic factors are no doubt extremely important in acquisition of language. If, for example, a child is asked to describe a very simple action (a farmer jumps over 10 fences to get to his farm), the child at once expresses action characteristics [Bronckart and Sinclair, in preparation]. However, the child makes use of different possibilities of the linguistic instrument to account for this semantic aspect of the action. Thus, the youngest ones used repetition or intonation (‘he has jumped, jumped, jumped, jumped, jumped … ’). From 4 to 6 years, the tense of the verbs was used to differentiate multiple jumps from a single jump (‘he jumps’ as opposed to ‘he has jumped’). Finally, after 6 years this aspect was expressed through adverbial phrases (‘he has jumped several times’). As with the comprehension of instruction given by the experimenter, there seems to be here a development within the semantic aspect of language; it is the transition of one type of semantic exchange to another rather than the transfer of the semantic aspect of the adult to the impulse aspect of the child with a final transition to the semantic aspect of the child’s speech.

It is therefore highly questionable that the evolution proposed by Vygotsky and Luria takes place – namely, the development from a regulation produced by adult speech to a regulation by verbal thinking with a transitional period of nonsemantic verbal self-regulation. Such a hypothesis is contradicted by the observed facts. Two types of phenomena seem to coexist in Luria’s experiments. On one hand, there is regulation by means of different contingencies, such as inhibition through the orienting reflex or initiation through verbal accompaniment. While this regulation remains to be analyzed, there is, on the other hand, comprehension of the instruction or of the rule.

In the experiments quoted, the instruction if given by the adult and the child must comprehend it. While nothing definite has as yet been demonstrated, one could speculate that there is a progressive internalization of the instruction at different ages and that this internalization is utilized to regulate behavior. But for Luria the utilization of this rule is due to explicit verbal
instruction, as if with the child there is an immediate correspondence between verbalization and thinking. While one can readily admit eventual existence of a particular rule, this existence in no way implies the possibility of verbalizing it, just as verbalization does not necessarily imply existence of an internalized rule. A majority of recent research in psycholinguistics indicates very considerable discrepancies between production and comprehension. Contrary to the first investigations in this matter (Fraser et al., 1963), comprehension does not necessarily precede production. Two types of production can be distinguished; one is early and is subject to the rules of childish thinking; the result of these productions are phrases that substitute for adult phrases. The other is late, is subject to the grammatical rules of adult thinking and in all cases results on phrases that conform to adult language. The first form of production precedes ‘grammatical’ comprehension, that is comprehension not aided by the situational context; whereas the second form follows the first with a very important delay of 1–3 years. Therefore, the capacity to verbalize a specific rule appears after the capacity to comprehend such a rule. Under such conditions it is highly unlikely that forced addition of a verbal instruction would significantly improve a performance without that addition.

There remains a last point for discussion which could be formulated in the following manner: What does Luria mean by language? Essentially it is at this level that confusion seems to arise between the Soviet theories and the Western interpretations. The second signalling system is by definition a system of representation; it consists of words which play the role of the unit representing signals of the physical world. In fact, the second signalling system is implicitly considered as the only system of organized representation. Acquisition of language is the only way to make possible the development of all mental functions since language makes it possible to operate mentally on these functions. In this view, language is the materialization of the intellectual operation, it is conscious thinking. The relation between language and thinking starts for Luria from these postulates with the result that he holds to a fusion of language and thinking rather than a dissociation of these two functions.

It seems, however, that this dissociation can easily be established. First of all, from the sensorimotor period onward – i.e., before the acquisition of language – the behavioral organization of infants shows a progressive construction of certain realities. These constructions are the source for further reformation at the level of conscious thinking as well as verbal thinking (Piaget, 1937; Mounoud, 1972; Mounoud and Bower, 1973). Mounoud [1972] investigated the construction of physical invariants and has shown how the child becomes progressively aware of the physical and spatial characteristics of objects. For example, Mounoud could observe what he calls an ‘active’ form of weight conservation at around 16 months of age. During the transition from this active to a conceptual form of conservation he did not find that the new behavior was regulated by language; rather there was a reconstruction at a higher level of what had already been elaborated at the sensorimotor stage.

One can distinguish two periods in language acquisition; a first one (from approximately 1½ to 3 years) where the verbal structures remain relatively simple and appear to be universal. During that period, there can be a strong correspondence between the structures of verbal representation and the cognitive structures, such as the relations of order and inclusion at the level of language and of thinking. But during a second period from 3 years onward, the syntactic structures develop both in complexity and in specificity; they become strongly differentiated along the lines of a specific language. Cognitive structures, in contrast, continue to develop along successive stages in a universal manner, tending by an internal necessity toward closure of these structures. At this developmental point, the distinction between language and thinking can therefore be clearly established, and numerous discrepancies between these two levels can be observed. Such discrepancies can go in either direction. They are found less in the semantic structures of language and in the lexical organization which seem to be much more dependent on the general intellectual development than the acquisition of syntax.

Luria focuses almost exclusively on the semantic aspect of language and neglects what seems to be the more specific linguistic aspect, i.e., the syntax. He attributes to this semantic system the role of organizing representation and conceptualization. This position is evident from an analysis of methods which Luria [1963] recommends for the reeducation of brain-injury patients. In this connection Luria cites as examples of language behavior every type of awareness, of conceptualization, of transition to a higher level of organization. Moreover, he localizes the regulatory function in the frontal lobe, while other language centers are situated in the parietal-temporal region. Significantly his method seems inadequate in two cases of deficiencies: mental retardation and agrammatism aphasia. This is due to different reasons. For retarded persons, there is an insufficiency in cognitive development which hinders the conceptualizations that Luria uses in his reeducation; for agrammatic aphasia, the failure of Luria’s method is due to its rigid
programming and the relatively ‘illogical’ character of syntactic structures.

In conclusion, it seems that Luria includes in the concept of language a certain number of processes which others, such as Piaget, call cognitive. At the same time he excludes a certain number of linguistic aspects which today are considered essential by both linguists and psycholinguists.

References


The Regulating Role of Speech


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