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Article *in* Journal of Russian and East European Psychology · May 2003

DOI: 10.2753/RPO1061-0405410304129

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Journal of Russian and East European Psychology, vol. 41, nos. 3/4, May–June/July–August, pp. 129–158.

ISSN 1061–0405/2003 $9.50 + 0.00.

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Roman Jakobson and the Development of Russian Neurolinguistics

On May 21–23, 1963, the symposium "Disorders of Language" organized by the Ciba Foundation was held in England. It brought together many outstanding specialists from different parts of the world: "neurophysiologists, psychologists, phoneticians, linguists, a philosopher and an expert in information theory" (*Disorders of Language*, 1964, p. vii). That was the time of early flourishing of psycholinguistics: the first seminar in psycholinguistics, which lasted two months, was held ten years earlier in Bloomington, [Indiana], N. Chomsky's book *Syntactic Structures* was published in 1957, J. Miller's well-known article on checking the psychological reality of transformational grammar appeared in 1962. Much was expected of psycholinguistics and first and foremost because of the development of computers—the technical miracle of the twentieth century.

 "Roman Iakobson i razvitie russkoi neirolingvistiki," in Roman Iakobson, *Teksty, dokumenty, issledovaniia* (Moscow: Rossiiskii Gumanitarnyi Universitet, 1999), pp. 382–401.

In this article the materials of Luria's archive were used (grant RHSF 98-06-80159). Also the author wishes to acknowledge partial support from NIH/ NIDCD ROI—DC00216 grant "Crosslinguistic studies in aphasia," principal investigator E. Bates.

In line with these expectations, the following question was formulated in the paper of Lord Brain, "The Setting of the Problem" (the first presentation at the symposium): "What anatomical and physiological processes underlie the coding and decoding of physical means of communication in language and their meanings" (*Disorders of Language,* 1964 p. vii).

Roman Jakobson was the next speaker. In his report [Towards a Linguistic Typology of Aphasic Impairments], he gave a linguosemiotic interpretation of the six kinds of aphasia distinguished by A.R. Luria. Luria himself did not participate in the conference as permission to go abroad was rare in the early 1960s. His report [Factors and Forms of Aphasia] was read by M. Critchley, the chairman of the symposium.

The symposium became a milestone in the development of neurolinguistics. The reports gave new hopes as they showed a new, neurolinguistic method (or, more precisely, different methods) of analyzing speech mechanisms. One of them dealt with revealing the primary defects underlying the diverse surface-level manifestations of aphasia. This method was based on the conception of the systemic structure of speech and other higher mental functions that was developed by L.S. Vygotsky and A.R. Luria. This was the method Luria wrote about in his report; this was the method linked to the classification of aphasia discussed in Jakobson's paper, and to which Jakobson connected the elaboration of the classification of aphasia.

The joining together of Vygotsky's, Luria's and Jakobson's ideas was natural and productive. This connection was bilateral and multistaged. The current report is an attempt to reveal the interaction of the people and their ideas.

The disciples of Vygotsky, and in particular, R.E. Levina (but not only Levina, as the daughter of Lev Semenovich, G.L. Vygodskaia, has stated), were convinced that Vygotsky and Jakobson had known each other. They were the same age, they studied at Moscow University at the same time (but in different departments), they attended the seminars of G.G. Shpet, and both

of them loved poetry and literature and belonged to similar literary circles. It would have been hard for Vygotsky not to notice the young red-head Roman Jakobson. As for Jakobson, as far as I know, he has never mentioned that he knew Vygotsky, although V.V. Ivanov remembers that as soon as Jakobson started visiting the Soviet Union again in the 1950s, he used the names of M.M. Bakhtin and L.S. Vygotsky in his first lectures (Jakobson, 1985, p. 13).[1]

Vygotsky's and Jakobson's approaches to language have much in common. Both of them share W. von Humboldt's and A.A. Potebnia's understanding of language as an activity, its creative nature and historic conditioning, its systemic structure, and the interaction of language and thought. This is clearly seen when we compare [*Thinking and Speech*] by Vygotsky (1934) and [*The Thesis of the Prague Linguistic Circle*] (1929), which was written with Jakobson's active participation. Debates surrounding Russian formalism and the movement away from formal methods to the consideration of language from a functional point of view, which was a crucial feature of Russian philology in the 1920s, were the basis for Jakobson's and Vygotsky's choice of a structural-functional approach to language. "The conception of language as a functional system" (the first Prague thesis) was close to Vygotsky who put forward the task of "studying functional systems and their fates" in his paper [On Psychological Systems] (1930) (vol. 1, p. 131).

The statement from the Prague Thesis that "every functional speech activity has its own symbolic system—language" (discussed by L.P. Iakubinskii (1916,1923), R.O. Jakobson (1921) and V.M. Zhirmunskii (1921), has become the main principle of Vygotsky's analysis of inner speech. Vygotsky reconstructed the characteristics of inner speech by comparing other functional types of speech, oral and written, just as linguists reconstruct the protoforms of words and sounds through analysis of their variants in the modern languages. (Luria will use the conception of inner speech developed by Vygotsky in analyzing the mechanism of dynamic aphasia.)

The consideration of a phoneme as a unit of sound speech was also close to Vygotsky's position. Having put forward the methodological principle of "the analysis according to the units," like F. de Saussure, Vygotsky stated that a similar shift of methodology had also been made in linguistics [*Thinking and Speech*] (1934). According to him, "the modern phonological approach in linguistics" has created a new understanding of the unit of sounding speech whereby it is "not a separate sound of speech, but a phoneme, that is, the phonological unit that is not further divisible, which preserves the main features of oral speech in its signifying function" (Vygotsky, 1982, [Collected works], vol. 2, p. 20). This statement[2] is a paraphrase of the definition of a phoneme from Jakobson's article [Notes on the Evolution of Russian Phonology . . .] published in the second volume of *Travaux du Cercle linguistique de Prague* (1929), a copy of which has been preserved by Vygotsky's disciple R.E. Levina.

Vygotsky applied the concept of phoneme in the analysis of speech pathology. On January 27, 1934, he presented a case of child aphasia along with a theoretical introduction [Analysis of Child Aphasias]. A record of this case presentation made by Luria is now in Luria's archives. Vygotsky points to "a phonological impairment" as a primary defect in speech delay of this child: "the acquisition of speech sounds is not structured, and that is why the mastering of all new words is going on anew." In the margins there is a note by Luria: "The acquisition of a group of new words in normal children = new opportunities." [Later we will discuss the differences between information processing strategies of the two brain hemispheres: systemic left hemispheric and "island" right hemispheric ones. Vygotsky's explanation of the problems of the child is very close to this modern understanding—T.A.] Subsequently, the syndromes of speech impairment with a primary deficit of phonemic hearing in children and adults were described by R.M. Boskis and R.E. Levina (1936) and A.R. Luria (1941, 1947).

Jakobson and Luria become the main dramatic personae of the

second stage of this interaction. Luria cites volumes 1, 3, 6, and 7 of *Travaux du Cercle linguistique de Prague* and Jakobson's article [Toward a General Study of Case] (1936) in his unpublished monograph [The Doctrine of Aphasia from the Point of View of Brain Pathology] (1940). They resumed their meetings in 1956 when Jakobson began visiting the Soviet Union. E.D. Khomskaia, who took part in these meetings, says that they resembled meetings between people who had known each other for years and she supposes that they met during Luria's first or second trip abroad before the war.[3]

Jakobson became more interested in problems of aphasia at the end of the 1930s. Children's speech and aphasia became the "main object" of his investigations, and that allowed him to prepare a paper on structural laws that govern the formation and disintegration of language for the fifth International Congress of Linguists in Brussels (1939). This work was continued subsequently in "Kindersprache, Aphasie und allgemeine Lautgesetze," published in 1942 in Uppsala. In this article Jakobson states that the construction of language systems and in particular the sound level of language moves according to the principle from maximal contrasts to more nuanced differentiations, and that, as a result, language and phonological systems are structured hierarchically. According to him, the vowels a-i-u (the primary triangle of vowels) and consonants p-t-k (the primary triangle of consonants together with the opposition "oral-nasal" acquired early) are most frequent in the languages of the world, the development of the sound system in children begins with these, and they are the most stable in aphasia.

I remember the discussion of this work in Luria's laboratory at the Burdenko Institute of Neurosurgery in 1963. The laboratory colleague studying sound impairments in aphasia, E.N. Vinarskaia, asked me (a speech therapist just starting out) to translate this article from German. She presented this translation that was commented on by Luria. Luria was again fascinated by linguistics at that time—S.I. Bernshtein and V.V. Ivanov (who published the

paper [Linguistics and the Study of Aphasia], 1962) visited the laboratory; S.M. Shur (Tolstaia) and E.L. Ginzburg also participated in its activities. N.I. Lepskaia appeared there somewhat later. Halina Mierzejwska, a linguist from Poland, spent several months at the laboratory. I do not remember who among the linguists participated in this very discussion. There were no doubts among clinicians that there are easier (more stable) sounds and more difficult sounds. (My own experience in speech rehabilitation in aphasics confirms that it is worthwhile to start the rehabilitation of pronunciation and differentiation of sounds from the contrasting oppositions of stable sounds identified by Jakobson.)

However, accepting Jakobson's conception as a whole, investigators of aphasia nevertheless had some doubts. The principal difficulty was that Jakobson gave a single hierarchy for all kinds of aphasia, but the clinical experience of Luria and his colleagues had shown that the gradations of difficulty in sound oppositions are not the same in sensory and motor aphasia: patients with impairments of phonemic hearing in sensory aphasia have most of their difficulties in distinguishing voiced and unvoiced, palatalized and nonpalatalized consonants, while patients with afferent motor aphasia substitute sounds that are similar in place of articulation and different in manner of articulation (*khalat–khadat*—see Luria, 1947, p. 123). Further investigations that discovered substitutions of sounds that are similar in place of articulation as well as in manner of articulation also confirm these doubts (Vinarskaia, 1971; Sumchenko, 1974; Kuz′min, 1979; Panasiuk, 1980; Kondratiuk, 1987).

These doubts are connected to a fundamental problem that is still being discussed in phonology—the problem of the status of the phoneme (as indicated in papers presented by M. Halle [1996] and S.V. Kodzasov [1996] at the Roman Jakobson Centennial Congress). What is behind the phoneme—acoustic representations (as Jakobson thought) or motor ones (as representatives of the "motor theory of speech" believe)? Jakobson preferred the acoustic correlates of distinctive features, first, because it allowed him to organize them as

minimal codes with the same description of vowels and consonants (metalinguistic argument), and, second, because impairments of phonemic hearing in sensory aphasia show the independence of perception of speech from the motor component (the neurolinguistic argument defended by Jakobson in his report at the seventeenth Psychological Congress in Moscow in 1966). But neurolinguists were aware of the fact that the data of aphasia might be used by proponents of "motor theory" because impairments of speech in afferent motor aphasia lead to specific defects of phoneme discrimination (see, e.g., Ryabova [Akhutina], 1968, p. 234).

These contradictions in the understanding of motor and acoustic components in sound perception are not by chance, they are rather connected to the complicated nature of speech perception mechanisms and their change during ontogenesis.

Research has shown that newborns distinguish phoneme oppositions in their own language as well as in other ones and the left hemisphere is more active during these processes, but the right hemisphere is more active while perceiving music tones (Molfese, 1973). In infants up to age sixteen months, focal impairments of the right hemisphere lead to more stable deficits in speech understanding; in children up to three years old, lesions of the posterior part of the left hemisphere (which is responsible for phonemic hearing and perception of oral speech in adults) lead to the underdevelopment of oral speech more than do impairments of other zones (Marchman et al., 1991; Thal et al., 1991).

In the early school years, deficits of sound distinction in writing, that is, a specific kind of dysgraphia is seen when the posterior part of the left hemisphere is undeveloped, but they are particularly persistent if right hemisphere functions are also deficient. Impairments of writing because of right hemisphere dysfunctions particularly affect vowels (even stressed ones) more than in the case of dysfunctions of the left hemisphere, which affects mostly the distinguishing of consonants (Velichenkova, Inshakova, and Akhutina, 2001).

In adults, impairments of speech understanding are expressed

much more in cases where the temporal lobe of the left hemisphere is affected (sensory aphasia); impairments of speech sound categorization are seen when temporal as well as central-parietal zones are disturbed (sensory and afferent-motor aphasia).

These facts (in accordance with the Vygotsky-Luria principle of the dynamic organization and localization of functions) show that the mechanisms of sound perception change with age—from broad involvement of the right and left hemispheres, to acoustic and motor parts of the left hemisphere being involved, and then mainly to the more local zone of the left hemisphere (temporal lobe) responsible for acoustic functions. In other words, phoneme distinguishing presupposes a complex functional organ with leading, background, and latent chains (the latter were necessary earlier but now used on special occasions, when leading operations cannot fulfill their job). As the hand teaches the eye, the eye teaches the hand, so the tongue teaches the ear and the ear teaches the tongue, but it is the eye that sees and the ear that hears. In adults, hearing is a leading modality in sound and word perception (both of which are impaired in sensory aphasia). If the Halle-Liberman position that "speech acoustic signals are interpreted in terms of articulatory activity" (Halle, 1996, p. 83) was right, then profound deficits of understanding would be seen in motor aphasia, but they do not occur. However, the view of Halle and Liberman is correct concerning a certain stage in speech development. On the other hand, a chief argument of their opponents (in particular, Jakobson) against the "motor theory of speech," which is based on the fact that a child with anarthria could understand speech (Lenneberg, 1962), is not very strong because this example shows how an understanding of speech might be forming, but not in the way that it usually does. At the same time, it cannot be forgotten (and this argues in favor of the involvement of motor functions in proper development of phonemic hearing) that children with difficulties in motor functions have difficulties in distinguishing sounds for a long time (Levina, 1940; cf. Nazarova's 1952 data on first-graders' difficulties in writing, and "biting" their tongues).

Thus, the discussion on the problem of hierarchy of the sound system and the status of phonemes, which began thirty-five years ago, allows us to suppose that from the neurolinguistic point of view, the phoneme is a complex structure that changes its functional organization with age, and that in adults, it is a unit of a complex acoustic-motor system of oppositions. It should be noted that some oppositions involve simple contrasts in both directions, while others are simpler in one or the other of them. The more complicated "the component structure of articulatory gestures corresponding to the features as whole symbolic entities" (Kodzasov, 1996, p. 84), the higher the probability of its disruption in motor aphasia; the more refined the sound difference with respect to the relative simplicity of articulation, the more probable is its loss in sensory aphasia. Nevertheless, Jakobson's main principle of the subordination of the sound level of language to structural laws is presented, albeit in a more complicated form.

Jakobson's next study devoted to aphasia [Two Aspects of Language and Two Kinds of Aphasia] was published in 1956 in his joint book with M. Halle. A translation of this work into Russian was made (as far as I remember) by M. Arapov, and S.M. Tolstaia brought it to Luria's laboratory sometime between 1962 and 1964. Luria was familiar with this work earlier (see Luria 1958, 1959), but the main idea of this study (or something similar to it) was assimilated by Luria before 1956.

In his 1956 work, Jakobson defended the notion that two operations, selection and combination, underlie speech processes and that they are disrupted differently in aphasia: combination is disrupted in motor aphasia (impairment of coding), while selection is disrupted in sensory aphasia (impairment of decoding). He compares these operations to two kinds of connections in language: similarity and contiguity. These connections were distinguished by Baudouin de Courtenay's disciple N. Kruszewski (1883) and became known in science through F. de Saussure. Luria writes in his scientific biography: "Saussure's ideas about two kinds of speech communication . . . I widely used in the 1940s thanks to

Roman Jakobson's works" (1982, p. 161). Which works does Luria mean? Or is his memory mistaken?

Luria (1947) in [*Traumatic Aphasia*] opposes the "nominative" and the "predicative, syntagmatic" sides of language, which is similar to F. de Saussure's division and to the "nominative language activity" and the "syntagmatic language activity" distinguished in the previously mentioned [Thesis of the Prague Linguistic Circle] (1929). Speaking about the brain bases of nominative and predicative systems, Luria relates them to the functions of the anterior and posterior areas of the cortex. This is in accordance with the principle of "joint work and reciprocal adaptation of posterior (gnostic) and anterior (dynamic) systems of the brain cortex" (Luria, 1947, p. 56), or, in other words, with the principle of "paired centers of the brain cortex, one member of which is in the posterior and another—always in the anterior part of the brain" (ibid, p. 63; later this principle was reconsidered and changed in favor of the idea of the interaction of three functional blocks of the brain. That is why it was not mentioned in the translation of [*Traumatic Aphasia* (1970)], where we find new data about the activation system of the brain).

Two years after the appearance of [*Traumatic Aphasia*, 1947], Luria wrote [On Two Kinds of Synthetic Activity] (published only in 1963), in which he distinguishes two kinds of operations of the brain. He follows I.M. Sechenov ([*The Elements of Thought*] 1878/1953) who distinguished between impulses entering the mind in simultaneous "spatial groups" and impulses integrated into successive "consecutive" rows.[4] We will discuss later (while speaking of Jakobson's dichotomies) whether these divisions proposed in 1947 and 1949 are the same.

The opposition of "impairments of syntagmatic and paradigmatic organization of speech" is not a central point in Luria's works up to 1973, when he published the article [Two Main Kinds of Aphasia] in the journal *Linguistics*. But this opposition becomes crucial in his book [*Basic Problems of Neurolinguistics*] (1975).

The opposition of selection/combination and corresponding

disorders of decoding and coding was just the first among those suggested by Jakobson (1956). In his London paper (1964), which we mentioned above, disintegration/limitation and successivity/simultaneity were also present (see Table 1).

The first opposition, related to "classical" impairments of coding and decoding—efferent motor aphasia (Broca's aphasia) and sensory aphasia (Wernicke's aphasia)—was readily accepted by aphasiologists, but the following two raised some doubts.

Let us start with the second one—disintegration/limitation. Jakobson opposed efferent motor aphasia, which is a wider syndrome, to dynamic aphasia (transcortical motor aphasia), a more limited syndrome. The syndrome of efferent motor aphasia involves difficulties in combining sounds into syllables and syllables into words (the phoneme level, according to Jakobson) and morphemes into words and words into sentences (the level of meaningful units according to Jakobson). Dynamic aphasia is characterized by difficulties in combining sentences into longer utterances.

Clinical experience shows that dynamic aphasia can manifest itself as an isolated impairment of speech, and it can also be a consequence after the disappearance of more severe symptoms of efferent motor aphasia (Luria, 1947, 1963; Luria and Tsvetkova, 1968; Ryabova [Akhutina], 1967, 1970; Akhutina, 1975). Both kinds of aphasia appear when anterior zones, which are the "morphological base of programming and realization of behavior at different levels of complexity," are damaged (Poliakov, 1966, p. 45). Thus, the genetic similarity between efferent motor aphasia and dynamic aphasia appears obvious.

The situation with impairment of decoding is quite different. According to Jakobson, the relationship of sensory aphasia to semantic aphasia also involves the opposition disintegration/limitation. However, sensory aphasia is far more similar to acoustic-mnestic aphasia, and it can be considered in terms of this opposition. Acoustic-mnestic aphasia was "unlucky"—it was not represented in detail either in Jakobson's or in Luria's papers in London. Sensory aphasia was described more fully—Jakobson sees impairment of the selection of

Table 1

Linguistic Classification of Aphasia According to Roman Jakobson (1964)

	Aphasia					
	efferent	dynamic	afferent	amnestic	semantic	sensory
Impairments of encoding (+) / decoding (–) = combination / selection = contiguity / similarity	+	+	+	—	–	–
Impairments of successivity (+) / simultaneity (–)	+	+	–	+	–	–
Disintegration (+) / limitation (–)	+	–	—	—	–	+

phonemes and words as its mechanism and remarks that "both kinds of disturbances may reinforce each other, but one could hardly deduce one of these two linguistic levels of disturbances from the other, that is, one could not trace disintegration of the verbal code to the disintegration of the phonemic code" (Jakobson, 1964, p. 28). If both impairments are similar, but independent, the impairment of one of those levels (especially of the upper one) can be seen in isolation—and this is the case in acoustic-mnestic aphasia.[5]

Sensory as well as acoustic-mnestic aphasia occur after damage to the temporal lobe of the left hemisphere. Similarly to dynamic aphasia, acoustic-mnestic aphasia can be seen in isolation or can be clearly noted in the backward development of sensory aphasia when deficits are disappearing at the phonemic level. The difficulties of phoneme differentiation, absent in a patient with acoustic-mnestic aphasia, appear again when the patient is tired.

Jakobson separated acoustic-mnestic aphasia from sensory aphasia on the basis of the third dichotomy successivity/simultaneity, believing that there is a deficit of understanding of coordinate words or sentences in the first of these. However, this is just one manifestation of the primary deficit, which involves difficulties in word selection (and, accordingly, difficulties in word retention). The perception of a word as well as a phoneme occurs through the accumulation of successive features:[6] at first a listener deals with contiguous elements; having accumulated them, he makes a decision—he selects a unit that is different from other similar ones by a simultaneous set of distinctive features (compare: "First the decoder is faced with the context, second, he must detect its constituents; combination is the antecedent, selection is a consequence, that is, the immediate aim of the decoding process" (Jakobson, 1964, p. 30). Thus, from Jakobson's point of view, we have to regard sensory and acoustic-mnestic aphasia as related, and to consider impairment of the selection of similar units on the base of simultaneous synthesis in them.

These kinds of aphasia are clearly opposed to efferent motor and dynamic aphasias in which the order of the operations is

reversed: first, the speaker makes a selection from a "syntactic" paradigm and then combines a successive row from contiguous elements (compare: "Encoding starts with selection. Selection is the antecedent, whereas building up the context is the consequence or the aim of the encoder" (ibid.).

These four kinds of aphasia are the most contrasting, and the concepts suggested by Jakobson are quite convenient for describing them, although with the correction that reconsideration of acoustic-mnestic aphasia has led to the unification of the dichotomies combination/selection and successivity/simultaneity (Ryabova [Akhutina], 1967). As can be seen from Table 1, Jakobson, on the basis of the last dichotomy, counterposed acoustic-mnestic aphasia and afferent aphasia. Merging two dichotomies raises a question about the status of afferent motor aphasia, which Jakobson considered an impairment of coding, that is, of combination into simultaneous structures (in contrast to efferent aphasia where there is an impairment of combination into successive structures).

Substitutions of and searching for sounds in oral speech and difficulties in categorization during writing are common in afferent motor aphasia. This aphasia can be considered an impairment of simultaneous selection in coding. When a speaker chooses a phoneme in its motor form, that is, an articuleme, he/she has a successive context—a syllabic motor program (the result of operations of the efferent type) and has to choose a simultaneous unity. Again the dichotomies combination/selection and successivity/simultaneity merge; at the same time, the dichotomies combination/selection and coding/decoding (which coincide, according to Jakobson) become distinguishable.

Nonlinguistic arguments also argue for such a reconsideration of Jakobson's dichotomies. According to Luria (1963, 1973), the synthesis of separate (even if successive) elements into simultaneous spatial schemas requires the activation of the posterior part of the brain (II functional block), while synthesis into successive rows requires activation of the anterior part of the brain (III functional block).

Such a reconsideration of Jakobson's dichotomies was carried out in my 1967 article (see Figure 1). At the same time, we reconsidered the status of semantic aphasia.

According to Luria, semantic aphasia is characterized by (1) difficulties in word selection connected to the disruption of semantic (categorial) connections of the word (Luria, 1947, p. 154), and (2) difficulties in understanding reversible grammar constructions. Jakobson included in his analysis only the second part of the semantic aphasia syndrome and considered it as a kind of weakened variant of sensory aphasia. In my 1967 article on speech production, only the first part was considered, as it was more related to the coding of an utterance. Difficulties at the word level were interpreted as impairments of word selection according to their meanings (supramodal selection) and they were opposed to impairments of word selection according to their sounds (lexemes) in acoustic-mnestic aphasia (selection in acoustic modality).

What about the second part of the syndrome of semantic aphasia? Before answering this question it should be noted that, in contrast to Luria, Western neurolinguists consider the above difficulties in comprehending grammatical constructions to belong to another syndrome—the syndrome of "conduction" aphasia (see, e.g., Berndt and Caramazza, 1981).

Specific difficulties in pronunciation constitute the crucial features in conduction aphasia, in which a patient who is trying to find a word looks over the right and wrong parts, but is not able to construct the right sequence out of them. For example, trying to say "okno" (window in Russian), the patient repeated "an . . . antro . . . ono . . . onto . . . no, not quite right" (Luria, 1975, p. 109). Luria considers this impairment as a kind of afferent motor aphasia. He pointed out in [*Traumatic Aphasia*] that in some patients with afferent motor aphasia, impairments of the sound sequence order are the most persistent ones (Luria, 1947, p. 322–26). Tzortis and Albert (1974) and Green and Howes (1977) consider the inability to set up the sound order to be a mechanism of conduction aphasia. Other investigators believe that the wider speech impairment present

Figure 1. **Reconsideration of Linguistic Typology of Aphasia**

[Tatiana] Ryabova's (Akhutina's) Point of View] (1967)

Encoding Combination Contiguity			Decoding Selection Similarity		
Dynamic	efferent motor	afferent motor	Semantic	sensory	mnestic
Successivity		Simultaneity			Successivity

Roman Jakobson's Point of View

in conduction aphasia involves motor as well sensory components of speech, but it is compensated for by language abilities of the right hemisphere, which deals better with fluent speech than with repetition and naming. As M.K. Shokhor-Trotskaia's (Burlakova) many years of experience show, conduction aphasia (as a rule combined with other syndromes) occurs more frequently in left-handed and ambidextrous individuals (Shokhor-Trotskaia, 1998).

Common to both explanations of the mechanism of conduction aphasia is that the left hemisphere does the work of setting up a sound sequence within a syllable or a word. This is an operation of the third type, its aim is to assign an articuleme (the result of a selection operation) to places within the syllabic structure of a word (a result of combination). A similar operation exists at the word level, its impairment leads to difficulties in understanding (more rarely—in constructing) grammatical constructions in semantic aphasia (in Russian terminology) or in conduction aphasia (in Western terminology). The name of the third operation, "assignment . . . to places" is borrowed from M. Garrett, who also distinguishes three types of operation in his model of speech production (Garrett, 1982; for a discussion see Akhutina, 1989, pp. 82–85, 120–22, 187).

The analysis of aphasias in light of Jakobson's interpretations allows us to compare classifications of aphasia that are used in Russian and Western traditions (see Figure 2). This opportunity is a result of Jakobson's work on the typology of aphasic impairments. I believe that Jakobson's main contribution to the study of aphasia was to overcome the atomism prevalent in traditional aphasiology. In the same way that studies of sounds suffered from atomism prior to phonology, our notions about aphasia did not constitute a system prior to Jakobson's classification. I will try to prove this.

Luria published his [*Essays in Psychophysiology of Writing*] in 1950. In this work, which anticipated cognitive psychology by decades, he gave a brilliant analysis of the cognitive processes involved in writing. This work was a model for me as I was writing [The Mechanism of Speech Production According to Aphasiology Data]

Figure 2. **Aphasia Classification in Russian and Western Neurolinguistics**

*See S.E. Blumstein, E. Baker, and H. Goodglass, Phonological Factors in Auditory Comprehension in Aphasia, *Neuropsychologia*, 1977, vol. 15.

**T. Shallice and E.K. Warrington, Auditory-Verbal Short-term Memory Impairment and Conduction Aphasia, *Brain and Language*, 1977, vol. 4, pp. 479–91.

in 1967. Following Luria, I distinguished the operations that are primarily disrupted in different kinds of aphasia. Following Jakobson, I took the next step: I proposed that at every level of speech production, each operation of combination has a corresponding operation of selection (this was in accordance with Luria's principle of "paired centers" mentioned above). This allowed me

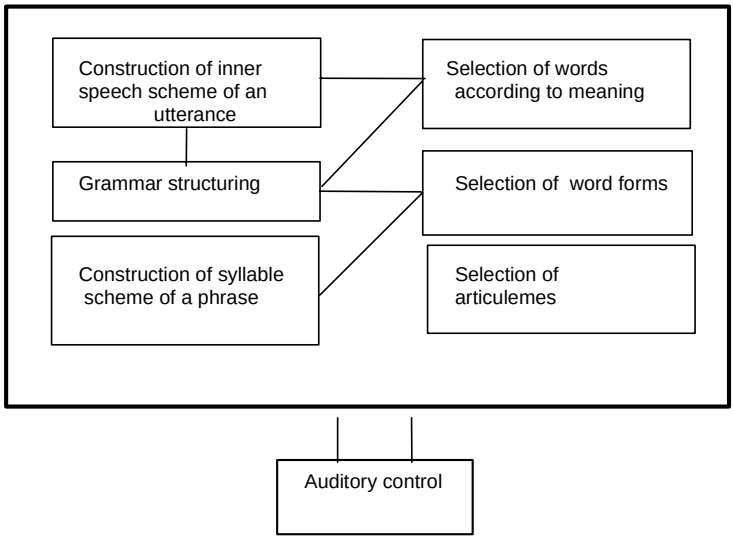
to suggest a model of speech production (see Figure 3) that is similar in its main features to Garrett's model, which is based on the analysis of speech errors, hesitations, and aphasia (Garrett, 1982).

Luria approved my point of view (see his [*Basic Problems of Neurolinguistics*, 1975], a book for which he invited the well-known Russian linguist I.A. Mel′chuk and me to be the editors). As was shown by A.A. Leontiev, our model of speech production was in accordance with theoretical conceptions and experimental data in psycholinguistics (Leontiev, 1969, 1974, 1997). The model was refined following further neurolinguistic investigations (see Figure 4), but its principal structure remained the same (Vinarskaia and Lepskaia, 1968; Tsvetkova, 1972; Kalita, 1974; Glozman, 1974; Tsvetkova and Glozman, 1978; Sumchenko, 1974; Vizel′, 1976; Akhutina, Polonskaia, and Tsvetkova, 1977; Polonskaia, 1978; Akhutina, 1989).

I would like to emphasize that this model of speech production appeared as a reaction to Roman Jakobson's 1963 paper. Jakobson operationalized primary deficits in aphasia and systematized them. It was possible to disagree with him concerning some details, but his ideas were productive and constructive.

Let us turn to the third stage of interaction between Jakobson and Russian neurolinguistics. If the first stage was a kind of "zero circle" where Jakobson, on the one hand, and Vygotsky and Luria, on the other, were constructing the theoretical base of neurolinguistics, and if the second stage was the period of aphasia oppositions, the third stage is a distinction between left and right hemisphere functions. At this stage, other people were involved besides Jakobson: L.Ia. Balonov, V.L. Deglin, and their colleagues, who were investigating higher psychological functions (mostly of hearing and speech) in unilateral electroconvulsive therapy (Balonov et al., 1976; Balonov and Deglin, 1979); N.N. Bragina and T.A. Dobrokhotova, who studied psychological changes in focal brain impairments (1977); V.V. Ivanov (1978, 1979) and Iu.M. Lotman, who actively participated in discussions on neurosemiotics.

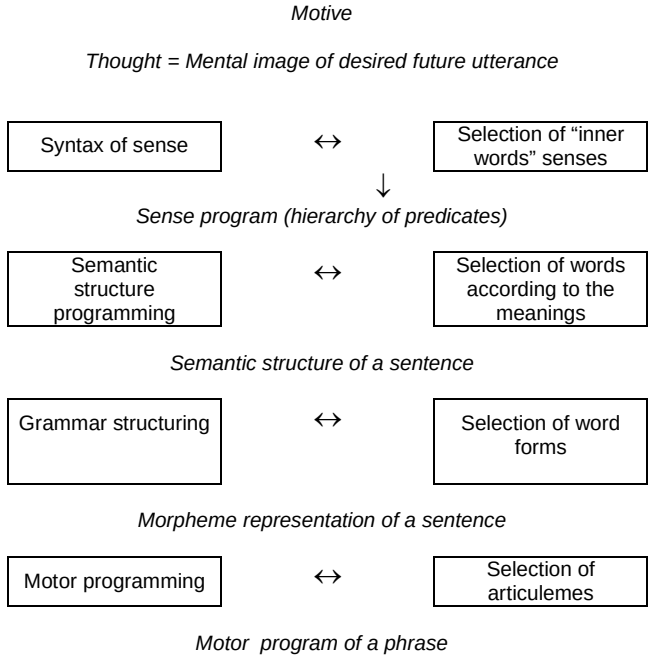
Figure 3. **Mechanism of Speech Production**



Source: T.V. Akhutina, Mekhanizm porozhdeniia rechi po dannym afaziologii [The Mechanism of Speech Production According to Aphasiology Data], *Voprosy porozhdeniia rechii i obucheniia iazyku* [Questions of Language Production and Language Teaching] (Moscow, 1967).

In Jakobson's study [*Brain and Language*] (1980), oppositions distinguished on the basis of studies in aphasia are placed in a new context—they become one pole of a higher level opposition where the other pole involves right hemisphere functions. I am not making a logical mistake in contrasting oppositions, on the one hand, and functions, on the other. In the tree of oppositions proposed by Jakobson, the right hemisphere side is represented by a terminal element (and this is not by chance), while the left hemisphere side is supposed to be further divided and terminal elements appear later. The main opposition is built on the principle of mediation: mediation on the left side and no mediation on the right side.

Figure 4. **A Model of Speech Production (Akhutina, 1989)**



Source: T.V. Akhutina, *Porozhdenie rechi: neirolingvisticheskii analiz sintaksisa* [Language Production. The Neurolinguistic Analysis of Syntax] (Moscow, 1989).

Discussing the differences of the left and right hemispheres, Deglin and I created the analogy: the right hemisphere deals with "the raw and the cooked," while the left hemisphere deals with half-finished products. Raw and cooked products can be taken as they are, half-finished products require analysis and synthesis. Human words are half-finished products, the results of previous experience and storage for the future, from which we prepare today's new sense. I remembered this conversation because our "right hemisphere" picture corresponds to the logical "left hemisphere" analysis of Jakobson.

How did Jakobson integrate the data of Balonov and Deglin?

First, he presents the strongest contrasts: mediated—speech, logical; unmediated—not speech, emotional. Next, he looks for unmediated things in speech itself: propositional speech is modulated, but interjections, clichés, and automatic tags are not. The system of phonemes is related to one pole, emotional features and intonation are related to another (we should mention the temptation to think that it is unnecessary to learn to perceive and repeat nonmediated things). This is far from being the case—a child is learning the full range of human feelings although the simplest emotional reactions are innate (see, e.g., Scaiffe and Bruner, 1975; Campos et al., 1989).

In summarizing the analysis of sound stimuli processing, Jakobson states that the chief ability of the right hemisphere in handling auditory percepts is to change them immediately into a simple, concrete concept lying outside of language per se. With respect to semantics, this statement means that impairments of the categorical meaning of a word are expected when the left hemisphere is inactivated and impairments of referential meaning (*predmetnaia otnesennost´*, according to Vygotsky)[7] can occur when the right hemisphere is inactivated. This was proved in a set of experiments. After Luria's well-known experiments in Central Asia and the investigations of his disciple P. Tul´viste, Deglin and his group asked their subjects to solve syllogisms. When the right hemisphere was inactivated, the subjects preferred to reach conclusions by staying within premises, while when the right hemisphere was active, they tried to involve their practical experience in decision making. Thus, when the following syllogism was suggested: "There are white nights in summer at the longitude of Leningrad. The city of Primorsk is situated at this longitude. Are there white nights in summer in Primorsk?" the same subject gave two different answers. When the left hemisphere was functioning he said: "Yes, there are, if it is the same longitude," and when the right hemisphere was functioning his answer was: "I don't know anyway how nights are in there, who knows where this Primorsk

is . . ." (Chernigovskaia and Deglin, 1986, p. 79; Deglin, 1996).

But the opposition "referential meaning is on the right, categorical on the left" holds only with a caveat. Whereas categorical meaning is inaccessible for the right hemisphere, the left hemisphere handles both referential and categorical meaning. This conclusion follows from the analysis of word meaning impairments in aphasia (Kalita, 1974; Tsvetkova, 1972; Akhutina, 1992, 1994), which shows that categorical meaning is impaired in semantic aphasia, while the connection "visual image- word" is disrupted in acoustic-mnestic and optic-mnestic disturbances. To a large extent, a word loses its function in organizing visual images, and not only the referent but also the connotative meaning of the word is disrupted (the patient does not know which animal is cunning and which is cowardly or to which the nickname "Blackie" belongs—the cat or the dog).

It seems that revealing the less mediated language relationships connected not only to the right but also to the left hemisphere makes us reject the correspondence of the dichotomy mediated/unmediated language phenomena with the left- and right-hemisphere functions. But this would be neither correct nor in accordance with Jakobson's opinion. Speech mechanisms were developed over a long process of phylogenesis, and multiple mediated language functions are a relatively new formation.

Shall we include diachrony as well as synchrony in describing speech mechanisms? Jakobson says in his article "Linguistics in Its Relation to Other Sciences": "The mistaken unification of two of Saussure's dichotomies— synchrony versus diachrony and static versus dynamic—was rejected by post-Saussurian linguistics. The beginning and the end of each process of language change also involves synchrony, corresponding states belonging to two approaches to the same language" (Jakobson, 1970, cited in its Russian translation [*Selected Works*] 1985, pp. 412–13). According to this thought, both newer (more mediated) and older (less mediated) functions can be expected to be left hemisphere functions.

The fruitfulness of Jakobson's approach to language and speech

development as well as to biological development in general is indisputable. It seems to me that when modern investigators say that Jakobson's ideas about the universal laws of formatting of the language sound system "were softly buried in the 1970s," they remain "adherent to absolutism," against which Sapir and Jakobson protested (Jakobson, 1970, cited in 1985, p. 405). They consider Jakobson's comprehension of internal connections and the relative and hierarchic character of language structures as just a restatement of facts, for example, that a child has the consonants p, t, k, m, and n, in the beginning. And if one or two sounds occur as voiced in the case of a particular child, they think that Jakobson is incorrect, without considering the fact that the voiced sound was a member of the same opposition described by Jakobson. Frequently, sounds from different subsystems—the hierarchically left hemispheric and the "island" right hemispheric—are considered together.

Throughout this article I have attempted to show how fruitful Jakobson's ideas were and how deeply they have influenced the development of Russian neurolinguistics.

To conclude, I would like to recall my only encounter with Roman Osipovich Jakobson, which was on March 5, 1982. I was in Boston, and he invited me to his house. Kristina Pomorska was not at home on that day. Roman Osipovich asked me many questions concerning Luria's archive, the health of E.D. Khomskaia, and other colleagues of Luria, and finished by asking where I lived in Moscow (the answer caused him to recall Lily Brik, whose flat was situated nearby). Roman Osipovich was full of plans to visit the Soviet Union: "I've been to Georgia, now it's time to go to Armenia." But these plans, unfortunately, were not realized. I presented my book (1975) to Roman Osipovich and in a minute we found another copy in the mountain of books under the table—this copy had been sent by A.R. Luria. Roman Osipovich inscribed his book [*Language and Brain*]: "as a sign of our common love for the inmost questions of speech." I would like to finish my article about Roman Jakobson and Russian neurolinguistics with these words.

Notes

1. The information about R. Jakobson and his circle in Petersburg-Petrograd was received from Vygotsky's cousin, D.I. Vygodsky who was close to members of OPOIaZ [Society for the Study of Poetic Language].

2. The definition of a phoneme as a set of differentiating features was given by R.O. Jakobson only in 1932.

3. In the Appendix to E.D.Khomskaia's book (2001) it is written that A.R.Luria met R. Jakobson in 1929 at the 9th International Congress of Psychology.

4. It is possible that N.V. Krushevskii, who was interested in psychology knew I.M. Sechenov's article and a chain was formed between Sechenov—Krushevskii—B. de Kurtene—Saussure—Jakobson and Sechenov—Luria—Jakobson.

5. Luria gives an example typical of a patient with acoustic-mnestic aphasia: a patient is retelling the story "A wolf and a goat": "Well . . . a wolf and that (wrong gender) . . . sheep, yes? or who? a goat? right? A wolf and a sheep . . . So, a wolf has seen a sheep (wrong gender) . . . no, it's not right . . . a wolf has seen a goat . . ." (1975, p. 126).

6. L.V. Bondarko (1996, p. 88) discusses the procedure of "using syntagmatic contrasts that appear in a sound sequence for phonemic interpretation of the acoustic signal."

7. Both R.O. Jakobson and L.S. Vygotsky distinguished "meaning per se" and "reference." This distinction can be traced to E. Husserl's notions: "Bedeutung" and "gegenständliche Beziehung."

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