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AUTHOR Johnsen, Birgitta
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ABSTRACT

A study of eight adult chronic aphasic patients' comprehension of sentences and pictures in which comparisons of time and space were crucial was designed to assess A. R. Luria's approach to designing comprehension test tasks. The investigation required patients, with lesions of varying size and location, to determine whether a sentence expressing temporal or spatial relations or a physical comparison corresponded to a picture presented with it. It was found that comparatives were easiest for the patients to understand, while spatial relations were more difficult, and the temporal relations expressed in the items were almost impossible for the patients to handle. It is concluded that Luria's writings about semantic aphasia and the processing of sentences expressing relationships should be modified, because in this study all aphasics, regardless of lesion site, were especially impaired on sentences where grammar governs syntax and grammatical markers are clearly abstract. According to Luria's theory, the patients' responses should have varied according to lesion site. It is suggested that Luria comes close to contradicting himself in proposing that one brain region should be more important than others in processing relatively complex sentences. (MSE)

SEMANTIC APHASIA AND LURIA'S NEUROLINGUISTIC MODEL

Birgitta Johnsen
University of Uppsala

1. INTRODUCTION

In a research project on assessment of aphasia different types of test tasks are evaluated with regard to their diagnostic value. A diagnostically valuable test task should ideally i.a.

- reveal possible deficits
- differentiate between different types of aphasia
- provide the basis for the setting up of a rehabilitation programme.

The present project includes test tasks using the dichotic listening technique and the visual half field technique but also conventional types of tasks i.e. spontaneous speech, repetition, naming, sentence and story comprehension. This paper only deals with the sentence comprehension task.

When constructing the sentences for the sentence comprehension task I was influenced by Luria's writings on this type of items (Luria 1976). That is why I paid special attention to items expressing logical-grammatical relations. I followed Luria's own examples and used sentences expressing comparative relations like "bigger/smaller than" and temporal relations as in the sentence "He went shopping after he had washed the dishes. What was he doing first?". According to Luria this type of sentences is extremely difficult or impossible for patients with semantic aphasia to handle.

2. SEMANTIC APHASIA

Semantic aphasia will follow a lesion of left hemisphere parieto-temporo-occipital cortex.

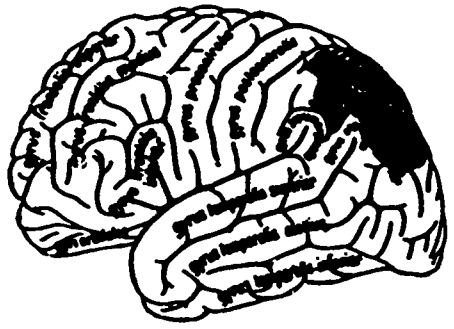

Figure 1. Approximate site of lesion in semantic aphasia as suggested by Luria.

The syndrome of semantic aphasia is described by Luria (1976, 1980) according to the patients' test performance as follows:

- fluent spontaneous speech with word finding problems and verbal paraphasias
- in dialogue there are problems with the understanding of complex grammatical constructions and especially those expressing logical-grammatical relations
- repetition of single words and simple phrases is unaffected but complex phrases are almost impossible
- naming is difficult and gives rise to verbal paraphasias. Prompting helps.
- reading is difficult. The patient cannot understand complex phrases. Some patients cannot get the words unless they try a letter by letter strategy.
- in writing there are problems associating the phonemes with the corresponding visual symbols, graphemes.

Of these symptoms Luria emphasizes the problems with understanding and use of complex grammatical constructions and the instability of lexicon although understanding of isolated words far exceeds the ability to handle complex grammar. Luria refers to a basic difficulty in performing spatial analysis of language. The lesioned zones (see Fig. 1) are indispensable for a complete analysis of incoming external information. These zones "combine successively arriving visual, tactile, auditory and vestibular stimuli into a single simultaneous schema, i.e., they carry out the simultaneous (spatial) synthesis of this information" (Luria 1976: 196). For verbal material this means "fitting incoming lexical elements into a single simultaneously surveyable logical-grammatical (quasi-spatial) structure" (loc.cit.).

3. METHOD

3.1. Patients

In my own project which has a case study design I have 8 patients, 4 men and 4 women. Their lesions differ in etiology and location. The lesions are at least three years old and consequently in a chronic state. (Etiology and lesion for each patient is shown below, Figs. 5-12.)

The patients have all been tested with different types of tasks and the traditional aphasia assessment was videotaped. The evaluation of these tests will not be discussed here. We will deal only with the sentence comprehension task.

3.2. Procedures

Some of the sentences were always presented together with a picture. Examples of this kind of sentence are the following:

A. THIS IS THE ELDER SISTER AND HER LITTLE BROTHER.
B. THE CAR IS SMALLER THAN THE BALL.
   THE CHAIR IS BIGGER THAN THE TABLE.

The sentence could be right or wrong in relation to the picture and the patients were to answer "yes" or "no" in reply to the statement given.

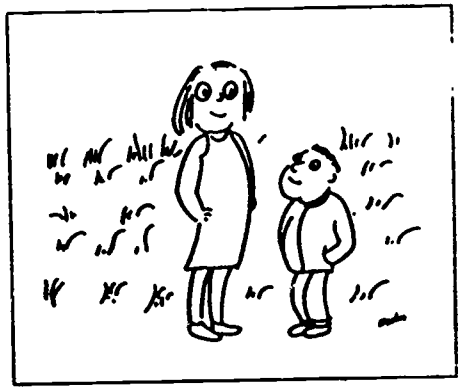

Figure 2. Picture shown with sentence A.

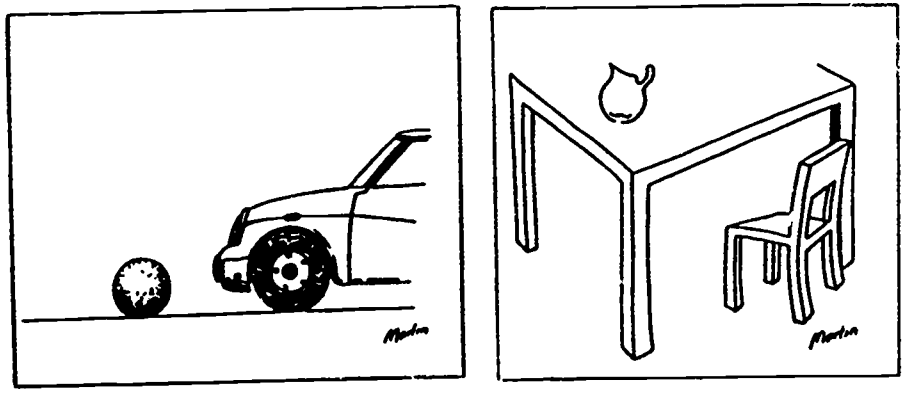

Figure 3. Examples of pictures shown with type B sentences.

Other types of sentences are these:

C. MY FATHER'S SON IS MY BROTHER. RIGHT OR WRONG?
D. HE WENT SHOPPING AFTER HE HAD WASHED THE DISHES. WHAT WAS HE DOING FIRST?

The latter type of sentence (D) requires more than yes/no-answer and patients without oral speech are offered pictures for a pointing response.

As a control there are also sentences such as:

E. FIRST HE WENT SHOPPING AND THEN HE WASHED THE DISHES. WHAT WAS HE DOING FIRST?

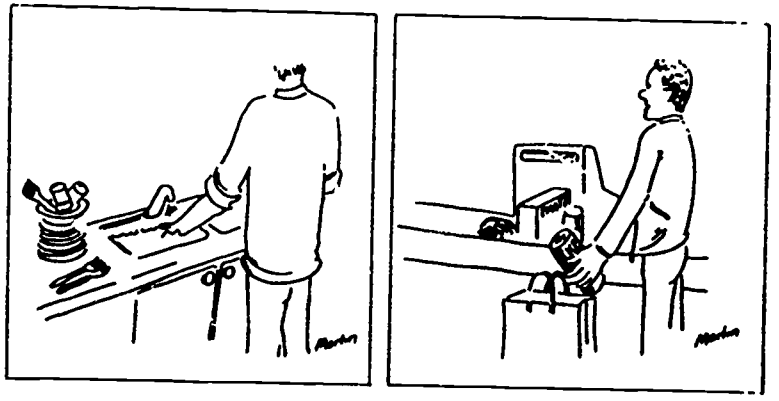

Figure 4. Pictures shown with sentence of type D and E for pointing response.

In all sentences I have used simple well-known words in order to stress the grammatical structure and not the lexicon. The testing procedure was characterized by Luria's philosophy about aphasia assessment. This means that test items are not only given and the result scored but there is a kind of dialogue between therapist and patient about the items and it is the outcome of this dialogue that determines scoring and not the very first answer from the patient. Even the patient is supposed to learn something about his language capacity during assessment. Doing it this way we used about 10 minutes for 15 sentences for this test.

The patients' ability to handle spatial relations expressed by prepositions was tested through the Token Test whose part V contains such items.

4. RESULTS

Table I shows the results summarized in plus or minus signs. The plus sign means that all sentences were correctly understood or that the patient failed the first one when a new type of sentence was introduced. Some patients need what might be termed 'a soft start' when facing new tasks and evaluation of cognitive flexibility was of secondary interest here. The brackets mean that the patient was able to understand the sentence with minimal help from the administrator of the test.

Table I. Performance on sentence comprehension task for 8 patients.

	AK	EG	HL	SN	BE	HA	NG	LA
The elder sister and her little brother	+	+	+	+	+	(+)	-	+
...bigger than... ...smaller than...	+	-	+	+	-	+	-	+
My father's son is my brother	-	-	(+)	+	+	+	-	-
He ... after he had ... What did he do first?	-	-	-	+	-	-	-	-
First he ... and then he ... What did he do first?	+	+	+	+	+	-	+	+

Brackets ( ) indicate that the patient needed some help to succeed with the task.

It can be seen that all patients except SN were impaired. Patient SN has a right hemisphere lesion and no aphasic problems.

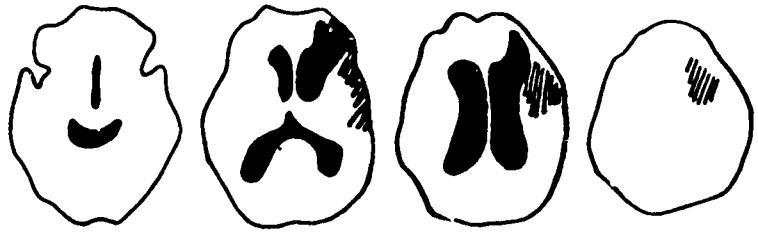

Figure 5. Pt. SN, male, age 64. Hemorrhage(s) at age 60 (and 61?). Lesion traced from CT scans.

One of the patients, NG, had problems with all the items. She has a large left hemisphere lesion.

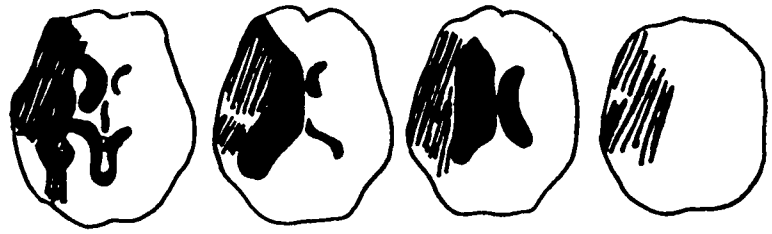

Figure 6. Pt. NG, female, age 55. Op. hemorrhage at age 34. Lesion traced from CT scans.

Patient EG's results were similar to NG's although he is slightly better. He has right hemisphere lesions with aphasia although he has always been a right-hander.

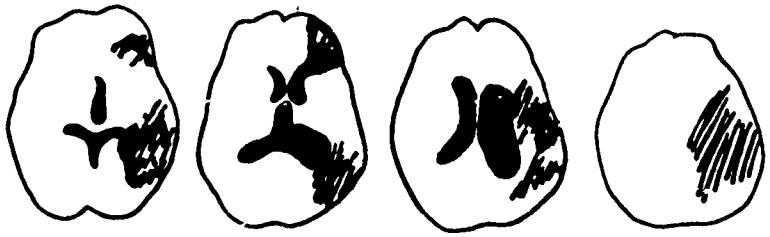

Figure 7. Pt. EG, male, age 64. Op. head trauma at age 55. Lesion traced from CT scans.

The results of AK and LA were rather similar. They both managed the sentences with adjectives expressing one relation but failed on the sentences where the grammar of syntax is crucial for understanding. Their lesions, however, differ with respect to site and etiology although there is overlapping of lesion location.

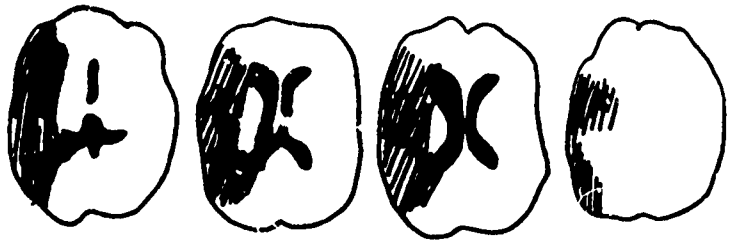

Figure 8. Pt. AK, male, age 62. Infarction at age 59. Lesion traced from CT scans.

Figure 9. Pt. LA, female, age 38. Hemorrhage at age 30. Lesion traces from CT scans.

Patients HL and HA had similar results although they needed some help with different types of sentences (indicated by brackets in Table I). Their lesions are certainly not identical but there is a great deal of overlap as regards lesion location.

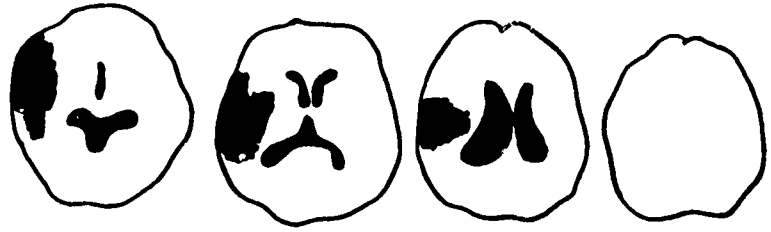

Figure 10. Pt. HL, male, age 41. Infarction(s) at age 33 (and 35?). Lesion traced from CT scans.

Figure 11. Pt. HA, female, age 64. Op. tumor at age 51. Lesion traced from CT scans.

Patient BE, finally, had problems with comparatives like "smaller/bigger" and temporal relations as expressed in Type D in sentences. She has a lesion along the central sulcus including Broca's area.

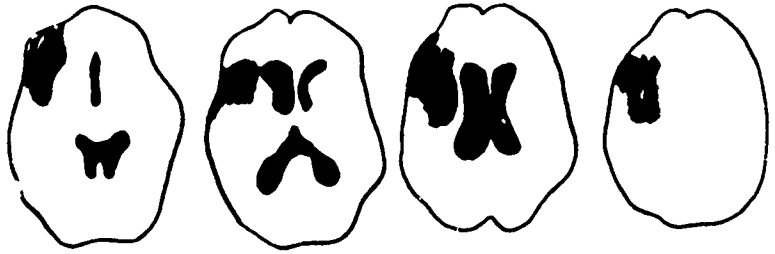

Figure 12. Pt. BE, female, age 64. Infarction at age 59. Lesion traced from CT scans.

Only two patients, SN (non-aphasic) and HA, passed the prepositional items of the Token Test without trouble. As can be seen from Table II they also had the highest total score on part V.

Table II. Performance on the Token Test, part V, which includes 6 items with prepositions.

	Total score	Prepositions
AK	6/21	4/6
EG	-	-
HL	9/21	5/6
SN	17/21	6/6
BE	6/21	6/6
HA	18/21	6/6
NG	5/21	3/6
LA	12/21	5/6

To summarize, comparatives were easiest for the patients to understand while spatial relations were more difficult and temporal relations, expressed as they were in the items used in this study, were almost impossible to handle.

5. DISCUSSION

The conclusion from these data can only be that Luria's writings about semantic aphasia and the processing of sentences expressing relations have to be modified. The sentences used in this study are exactly comparable to Luria's own examples and all the aphasic patients irrespective of lesion site were impaired especially on sentences where grammar governs syntax. In these sentences the grammatical markers are clearly abstract.

In sentences of Type A and B (elder/bigger/smaller) you may easily picture the different concepts for yourself and comparatives like "bigger" and "smaller" might be processed like lexical units and in the word order given. However, in sentences like Type D (HE WENT SHOPPING AFTER HE HAD WASHED THE DISHES) it is not sufficient to understand "shopping" and "wash the dishes" because the words "after he had" are of great importance and moreover, they "destroy" syntax which has to be understood "backwards". This kind of temporal relation was difficult for all the aphasic patients.

The understanding of spatial relationship through prepositions is hard to evaluate from this study. According to results of the Token Test all the aphasics except HA had some difficulties with the understanding of prepositions. Only HA performed without errors but, on the other hand, none of the patients failed on all items. It is possible that some patients found the lexical units of the sentences (e.g. "black circle, white rectangle") slightly unfamiliar and thus hard to understand. This would lead to poor performance on this task. As already mentioned, the sentences of my own test only contain highly familiar words.

In 1980 Hiar et al. published an article entitled "Semantic aphasia: A neglected entity". They presented three cases diagnosed as semantic aphasics. Hiar et al. emphasized that all three cases were impaired in their understanding of grammatically complex constructions and that they had been especially examined with regard to the understanding of sentences expressing different kinds of relations.

Hiar et al. found that the patients' understanding of comparatives was good. This result is supported by the study in this paper. Luria postulated that the understanding of comparatives is impaired in semantic aphasia. Hier's findings do not support Luria in this respect. Understanding of passive sentences and sentences expressing spatial and temporal relations was impaired in Hiar's patients.

Of the three patients in Hiar's study one had bilateral lesions and it seems unwise to refer to such a case. The only data on lesion location for the remaining two cases are early CT scans from the first week after stroke (infarction). These scans show lesions of about the same area as Luria suggested for semantic aphasia. It is far from likely, however, that the lesion area is reliably shown in the first week after a stroke.

Even though Hier's data seem to confirm Luria's description of semantic aphasia symptomatology and lesion location (at least for two of the patients) it is a serious shortcoming that patients with different lesion location and different aphasic syndromes have not been given the same tasks.

In several works Luria presented what might be called a neurolinguistic model based on a more general neuropsychological model. His ideas about brain-language relationship are often described in close connection with clinical findings (Luria 1970, 1976, 1980).

Luria emphasized that all mental operations are the result of a functional system where different parts of CNS are contributing to different aspects (or qualities) of mental activity. When referring to language behaviour he made a front/back dichotomy where the anterior part of the brain was thought of as being

responsible for syntagmatic organization of language and the posterior part for paradigmatic organization. Syntagmatic organization should be seen as the application to language of an underlying basic psychological ability for the programming, regulation and verification of behaviour. Paradigmatic organization reflects an underlying basic psychological ability for integration and spatial analysis of incoming information. Luria claimed that complex grammatical structures and especially those expressing relations, which certainly have a "spatial" quality, are mainly dependent upon intact posterior tertiary areas of the left hemisphere.

Although Luria strongly emphasized that language behaviour always requires syntagmatic as well as paradigmatic organization he claimed that a qualitative analysis of aphasic language can reveal which aspect of language organization has been most impaired. When describing different aphasia syndromes Luria used concrete examples of test performance to show how different syndromes affect different aspects of language. As regards semantic aphasia the present study shows that understanding of sentences expressing relations was impaired in all aphasics irrespective of lesion site. Perhaps a more refined analysis of the performance could reveal interindividual differencies. It is hard to believe, however, that any specific brain area could be of special importance for understanding of such a complex sentence as "HE WENT SHOPPING AFTER HE HAD WASHED THE DISHES". It seems more likely that syntagmatic and paradigmatic processing must be almost equally involved. It is in a way contrary to Luria's own writings about brain language relationships that one brain area (or region) should be more important than others for processing of such complex grammatical structures. The only reasonable dichotomy concerning brain function in this case could be a left/right one. Most probably it was for educational reasons that Luria made the descriptions of his aphasia syndromes so clear-cut that he comes close to the position of a true localizationist which certainly is in contradiction to himself.

Let us now go back to the beginning of this paper and the criteria for diagnostically valuable test tasks. The first criterion to reveal possible deficits seems to be met in that all the aphasics had some difficulties with the task, whereas the non aphasic patient did not. What remains to be shown is whether the difficult sentence (Type C) really can be understood by the average person! The second criterion, differentiation between different types of aphasia, has not been met. Patient AK and LA showed exactly the same pattern as regards understanding but their total clinical picture differs widely.

This leads to problems with the third criterion. If the task does not differentiate between different types of aphasia, it gives no clue about the origin of the defect and hence very little guidance for rehabilitation. Perhaps it is futile to expect that a task involving comprehension of "spatial" grammar should differentiate between different types of aphasics? The more complex the task the less probable it should be to find specific brain correlates to behaviour.

In order to reveal a true spatial deficit it would be wise to start with simple tasks and confine oneself to a greater number of sentences with e.g. comparatives and spatial relations. To minimize the effect of very special individual processing strategies a large group of patients should be examined.

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