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APRAXIA OF SPEECH IN A MULTILINGUAL APHASIC:

A CASE STUDY

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ABSTRACT

A description is presented of a patient who, after a cerebral trauma in the left frontal lobe and a presumed CVA, exhibited a severe and lasting disorder of speech production. He also showed impairment of reading and writing, accompanied by mild impairment of language comprehension. In addition, he exhibited oral apraxia, which subsided sometime after the accident.

The symptomatology exhibited by this patient is discussed with the view to contribute to accurate differential diagnosis between Broca's aphasia and speech apraxia.

The need for finer criteria of differentiation between these two syndromes is emphasized. Attention is drawn to some of the inaccuracies in the existing criteria and some suggestions for their improvement are offered.

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1. THE CASE OF SAID A.

1.1. Personal data

Name: Said A.

Sex: Male

Date of Birth: 23/04/1971

Mother Tongue: Arabic

Other Languages: French, English, Spanish, Dutch.

Education: Completed secondary school and started a vocational training in tourism.

General Health: No history of previous health problems.

1.2. Anatomical findings

On September 5th, 1992, Said A. was involved in a car accident and suffered a frontal cerebral trauma and presumably a CVA in the left hemisphere. As a consequence of his brain damage, this 21 year-old patient lost the ability to express himself both orally and in writing. When I first saw him, on October 16th, at the VUB's Academic Hospital, he was unable to utter any word, with exception of the stereotypy /nini/, which he produced whenever he attempted to speak. While his speech comprehension was only mildly impaired, his reading comprehension was severely impaired. He had no dysphagia, showed a moderate degree of oral apraxia and was hemiplegic on the right side.

The medical report stated that Said had a cerebral contusion on the left hemisphere. The Echo duplex showed vestiges of a great obstruction in the left internal carotid artery. This narrowing had its origin on the posterior communicating artery. The nature of the narrowing suggested that, even though at the moment that the angiogram was taken (October 1992) there was a relatively good flow of blood, it was very likely that one month

before, the blood flow was slower and the patient had probably had a CVA. The neurologist also noticed, on the CT-scan, that the contusion extended from the frontal-basal to the fronto-parietal lobes. There was an heterogeneous left parietal hypodensity peri-insular with very localized and dense zones, which the neurologist suspected to be the sequelae from the haemorrhagic contusion.

A CT-scan, taken in the service of urgency soon after the accident, showed a loose bone fragment in the left hemisphere which injured the dura mater. Another CT, taken days later, showed a left frontal fracture, an oedema on the left frontal lobe with a contra-coup occipital lesion and no hematoma. A control CT-scan, taken at the beginning of October, showed a clear reduction of the oedema, but an infarct in the area of the left middle cerebral artery.

On the day of the accident there was no paralysis but the patient was hyperkinetic in bed. The next day, right paralysis on the right arm was observed.

1.3. Neurolinguistic findings

A comprehensive test battery, in French, was constructed to evaluate this patient's disorders. Items were selected from standardized tests of aphasia such as the Boston diagnostic aphasia battery (Goodglass and Kaplan, 1972), the Tokentest (Van Dongen et al., 1976), the Aachener Aphasie Test (Huber et al., 1980), the "Plan de L'examen clinique des aphasiques" used in the Centre du langage de l'hôpital de la Salpêtrière (Lhermitte and Ducarne, 1965) and the "Protocole d'examen `phonétique-phonémique'" (Lecours et al., 1969). The battery was devised on the basis of systematic empirical observation of what characterized this patient's difficulties. A sensitive range of

difficulty within each type of language performance was also included in order to reflect degree of impairment, progress or regression in therapy, which he received three times a week at the Brugman hospital.

Repeated systematic observations were made. The patient was visited by me, once a week, for nine months. Each visit lasted approximately one hour. In each visit, a test or part of it, was administered. In addition, part of each session was allotted to spontaneous "conversation", during which the characteristics of his attempts at producing speech and written language were carefully observed. Due to the fact that I am not a native speaker of French and I do not speak Arabic (the two languages in which the patient showed some recovery), I requested the help of two colleagues fluent in these languages to administer some of the tests. I was always present and I scored the tests and analyzed the results in order to ensure a certain uniformity of procedures. I will not report the results of the tests in Arabic, since the examiner spoke a dialect different from that previously spoken by the patient. The results may have been influenced by the fact that the patient did not understand the examiner's dialect.

1.3.1. The oro-facial apparatus

This patient had oral apraxia which later subsided. Of eleven oral movements we asked him to perform, approximately one month post onset, there were several that he was unable to do. The movements and respective performance were:

Closing his eyes: He did that correctly.

Pursing up his lips: He opened his mouth a little and slowly and

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softly closed his lips without pursing them. When shown how to do it, he did it in a slightly distorted way.

Whistling: He could not whistle despite the fact that he could do so before the accident. He managed to make the movement but no sound came out. For this act he pursed his lips very well, though he was not able to do that for the previous task.

Puffing his cheeks: He opened his mouth and moved his lips slightly.

Blowing: He could not blow. When shown how to do it he did push some air out of his mouth, but without pursing his lips and building up intra-oral pressure. When a burning candle was held in front of him he blew it only after a few trials.

Protruding his tongue: He did this correctly.

Placing his tongue to the right and to the left: He did this correctly.

Moving his tongue upward: He did this correctly.

Clearing his throat: He wrinkled his brows, made some movements with his head, but did not succeed at clearing his throat.

Coughing: He could not cough. He moved his head and even his shoulders, but no sound came out. Even when shown how to do it he could not imitate.

While trying to cough he uttered sounds like, /pji/, /ã/,

si/, /ala/.

Blowing his nose: He held the handkerchief in his right hand, with difficulty and made the gesture of blowing his nose without producing the characteristic sound and movement.

At the end of November 1992, Said could already whistle. He could also produce the "frontal click". In December 1992, he could cough.

1.3.2. Expressive language

1.3.2.1. Oral Expression

a) Spontaneous Speech

Phonetic, phonological and prosodic levels

Numerous phonetic and phonemic errors occurred, including substitutions, omissions, additions, perseverations, metathesis and distortions¹:

- * substitutions predominated and outnumbered omissions, additions and distortions put together. For example, when saying the seven days of the week he made 11 substitutions, 2 omissions, 2 additions and 1 distortion;
- * he made perseverative but no anticipatory errors during his attempts at producing spontaneous speech. Perseverations occurred within words (e.g., the /d/ of the word "dimanche" (Sunday) was repeated on the third syllable and the word was

1. In the phonetic transcription a dash means syllabification, and reticences mean a longer pause or hesitation.

pronounced as /dimādR/. They also occurred across word boundaries. For instance, after succeeding at producing the word "médecin" (doctor), he wanted to say the word "maison" (house), but he could not stop saying /s / (the last syllable of the previous word), several times;

- * his errors were unpredictable. For example, he would sometimes pronounce the word "médecin" (doctor) correctly, but minutes later he would say the same word in the following way: /met t / or /med t /. The word "banane" (banana) was pronounced sometimes as /nanan / and other times as /banad /; thus, if mispronounced twice, errors were often each time different;

* there were only a few metathetic errors. For example, the word "femme" (woman) was pronounced as /m f/;

- * at the initial stages after the accident plosive and fricative phonemes evoked many errors (examples / / --- /s/; /s/ --- /f/; /p/--- /pj/; /b/ --- /t/; /k/ --- /t/; /z/ --- / /). Plosives were the first to be recovered and towards the end of my visits, he still had difficulties with fricatives;

- * he often created consonant clusters, For example, "tête" (head) --- /t tR /; "dimanche" (Sunday) --- /dimādR / and /didātR /. The cluster /tR/ was favored;

- * the non-sequential substitutions made by this patient during spontaneous speech, tended to take place within a short articulatory distance. i.e. the phoneme actually uttered and the target phoneme often did not differ by more than one or two

distinctive features.

For example, when trying to pronounce the word "Chine" (China), he substituted /s/ for / / --- /sin /; when attempting to pronounce the word "médecin" he substituted /t/ for /s/ --- /med t /.

- * sounds tended to be slightly protracted, especially in long words, but the intensity variation across syllables was normal;
- * he made many pauses between syllables. However, these pauses were not always after each syllable. They were very irregular, i.e., sometimes he would pause after one syllable, other times he would pause after two syllables. For example, when pronouncing his last name, which has three syllables, he made only one pause between the first and the second syllables, but no pause between the second and the third syllables.

morphological level

- * he could not say any word except the stereotypy /nini/. Later on, he added to this repertoire the words "oui" and "non" (yes and no), the word "merci" (thank you) and the days of the week. On one occasion (October 1992), he exclaimed, expressing irritation, the following expression: "un moment" (a moment);
- * during the first 10 minutes of spontaneous conversation, on May 15th, he produced accurately and appropriately the following words, which had not been used spontaneously during previous sessions: "peut-être" (maybe), "vendredi" (Friday), "tête" (head), "tête mal" (head bad), "merci" (thank you). Only at this stage, eight months after the accident, did he start to apply

some of the words recovered spontaneously and through therapy at the Brugman hospital. He complemented his attempts at producing speech, with written expression. At the end of May he still wrote only single words, but those were written completely and, often, correctly;

- * by June he could already say his own name correctly. However, at times, when asked his name he would grope for a while in vain and then resort to writing it down. If prompted with the initial sound he would then say it correctly. This happened with a few other words which he had relearned during therapy.

semantic level

- * singing, recitation of automatized series, and expletives, were all impaired;
- * he made some semantic paraphasias when saying numbers; while writing the number seven he said "cinq" (five), and when he was writing the number sixteen, he said "dix-neuf" (nineteen). He also made a semantic paraphasia when wanting to say "jus" (juice); he said, instead, "café" (coffee).

b) Word Reading and Repetition

Oral reading and repetition were impossible during the first two months after the accident. In his attempts to produce a syllable or a word, he either produced no sound or a sound completely different from the one demonstrated by the examiner. Later, his repetition improved, but his oral reading remained grossly impaired. For example, of a list of twelve words, only three were correctly read, while seven were correctly repeated.

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On another occasion, he made 4 errors when repeating 36 words and 28, i.e. nearly 66% more when reading aloud the same words. A few months post onset, prompting with the initial sound of a word helped him to pronounce the desired word correctly. For example, after seeing him grope for a word like "jeudi" (Thursday) I said / / and he would be able to immediately say / di/. On other occasions, I just made the movement of the initial sound without producing any sound and he would also be able to say the intended word. This did not happen with all words, but with several of them as, for example, with "pain" (bread), "mot" (word), "pot" (jar), "main" (hand), "pâtes" (paste), "pile" (heap). When asked to read 30 mono-, bi-, and trissyllabic words extracted from the "Plan de L'examen clinique des aphasiques", on March 15th, he could not initiate most of the words. When prompted with the initial sound or syllable, he produced sounds very different from those that had been prompted and several paraphasias were observed. In May, initial sounds were already correctly pronounced, however, they were often the only correct sounds. Sometimes, when he was not able to initiate a sound he wrote the initial letter of the word he wanted to pronounce and asked me to pronounce it while he looked attentively at my lips. He then tried to imitate and after a few trials generally succeeded. Phonetic transcriptions of his reading and repetition of mono-, bi-, trissyllabic words can be seen on appendix 1;

Below is a discussion and examples of the reading paraphasias made by this patient on different occasions:

* substitutions were the most common paraphasia. Most of these substitutions were non-sequential and they were more numerous

than sequential substitutions (e.g. from the list of 14 words on appendix 1 (a), he made 5 non-sequential errors, and 2 sequential; from the list of 30 words read on March 15, he made 19 non-sequential errors, and 4 sequential errors; from the list of 34 words on appendix 1 (b), there were 12 non-sequential errors and 9 sequential errors). Very often there seems to be no resemblance between the target sound and the sound produced. For example, when trying to read the word "lit" (bed), after I said /li/ he tried to imitate by producing the following sequence of sounds: /kā...nō (no, meaning that he had realized his mistake)...pi...pa...ma...mo/; when trying to say "rat" (mouse) he produced the following: /tā...to... ta...da...ta/. After demonstration he produced /R...t...j ...ja/; when trying to pronounce the word "vent" (wind) he said /kā...gā...zā/; when trying to pronounce the word "cabinet" (closet), he substituted /li/ for /bi/. In many cases, however, the articulatory distance between the target sound and the sound produced is very short. For example, when attempting to say the word "tâche" (task), he uttered /tas/; in his attempt to say "dent" (tooth) he said /tā/; for the word "sac" (bag) he said /fa/; for "chat" (cat) he said /sa/; for "médecin" (doctor) he said /met t /; and while trying to say "zèbre" (zebra) he said /tR /; and he substituted /d/ for the second /n/ in "banane" (banana);

* anticipations and perseverations within words occurred sporadically and the numbers of occurrence between the two types of paraphasia did not differ much (e.g. in lists a and b in appendix 1, there were 4 anticipations and 3 perseverations within words). For example, when trying to say "médecin"

(doctor) he said /met t /, substituting /t/ for /s/ in what seems to be a perseveration of the first /t/; when trying to read the word "sabot" (clog) he said /bo/ anticipating the second syllable of that word; when saying the word "bassin" (basin) he said /s / also in anticipation of the second syllable; and when trying to read the word "problème" (problem) he said /bobl m/, also an anticipation;

In addition, when attempting to say "banane" (banana) he anticipated the nasal /n/ and produced the following /nanan/; when trying to say "café" (coffee) he said /ka-ko...ka-se...va-fe...fa/. The last three sounds seem to have been produced in anticipation of the second syllable of the word "café";

* many perseverations across word boundaries were observed. Very often the first sound he uttered when trying to read a word, would be part of a word (a sound or a syllable), or even the whole word, read previously. For example, when trying to read the word "vent" (wind) he first said /Ra/ which he had read a few minutes before; when trying to read the word "femme" (woman) he said /mā...mā...p ...v m...v n / he had just finished saying "maman" (mamma); when trying to say the word "banane" he uttered the words "poule" and "gants" which he had just said, he went on groping for the correct pronunciation while previous words kept cropping up /pu...pu...pul...gā...ma/;

* as he did in spontaneous speech, he often created consonant clusters when reading. For example, /dimādR / and /didātR / for "dimanche" (Sunday); /vakātR /, /vatRā / and /vakāts/ for "vacance" (holiday); and when attempting to say the word "zèbre" (zebra) he said / tR /. As in spontaneous speech, the

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cluster /tR/ was favored. On the other hand, he also, and more often, reduced consonant clusters as for instance, /sat / for "station" (station); /adiR / for "admirer" (to admire); /spetat / for "spetacle" (show); /m Rt di/ for "mercredi" (Wednesday);

* sometimes he could, without any help, and after numerous trials produce the target word or, at least, an approximation of it. for instance, when trying to read the word "vent" (wind) he said /la...Ra... fā/, and finally /vā/, or the word "tu" (you) he said /ku...ka...g...ga...ty/ (more examples can be seen in appendix 1);

* when reading the days of the week, there were also several paraphasias. Several substitutions, collision of two days of the week "mardi" and "mercredi" --- /m R...m R-di/; perseverations across word boundaries --- /m R...di/; cluster reduction --- /m R-d -di...m R-m R-t -di/; and cluster creation --- /di..di-mā-dR...di-dā-tR ...di-mā-tR/

* reading a list of numbers, from 1 to 30, was correctly done until number seven. From then on, several difficulties, including both semantic and phonemic paraphasias, occurred:

- "sept" (seven) --- /sāk/(five).../sets/(sevens).../sis/(six).

This is clearly a semantic paraphasia;

- "neuf" (nine) --- he was not able to pronounce it, but repeated

correctly after my model;

- "treze" (thirteen) --- with the prompt /tr / he could pronounce correctly the whole word;

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- "catorze" (fourteen) --- with the prompt /k/ he was able to pronounce the whole word;
- "seize" (sixteen) --- /dizn v/ (nineteen). When asked to show the number nineteen he did so correctly. This seems to be again a semantic paraphasia;
- "dix-sept" (seventeen) and vinte sept (twenty seven). He could only say the first half of the number, i.e., he had difficulty with the number seven;

* he was not able to read short sentences. Therefore, I read each sentence pausing after every word, and I asked him to repeat each word after me. Repetition was extremely laborious, almost impossible. In this reading, substitutions outnumber any of the other types of phonemic paraphasias. For example, while reading the seven sentences below, this patient made 16 substitutions errors, 4 additions, 1 omission, 1 metathesis, 2 cluster reductions, and 4 cluster creations. Perseverations outnumber anticipations. There were 5 perseverative errors (1 within a word and 4 across word boundaries) and only 1 anticipation.

The following are sentences repeated by this patient and the corresponding phonetic transcription (March):

"Nous partons en vacance" (We are leaving on holiday)

/nu...paR-paR-tõ...ã...va...va-tRã...va-va-va-kã-t...va-kã-tR ...va-kã-ts /

"Le médecin guérit les malades" (The doctor cures the sick)

/m R-m R-m -d -s ...m - t tã...de-de-de (I prompted with /ge/)... de-Ri... e.. geRi...de-de...le...ma-la- ...ma-la-dR /

--

"Il est sorti" (He left)

/l ...l ...l ...il...e...soR-si...soR-tsi

Reading of short sentences, a few months later (June):

"le professeur ecrit dans le tableau" (the teacher writes on the blackboard)

/l...le..la...p lot ...pofes...fRoR...pRos...pRofes R ...(I had to say the following word and he repeated) ekRiR
d...a....le..../

"l'homme lit le journal" (the man reads the newspaper)

/loms ...li..lo...la...l ulal ...(on repetition) uRnal /

"Ils se disputent" (they are arguing with each other)

/...(could not initiate so I said the first word and he tried to repeat it) li...a...sa..so..so...nõ...(on repetition)
...dil...dis-py-t /

"le police arret le bandi" (the policeman arrests the thief)

/a...nõ...l...p li (self correction) p lis
...aR...aR...aR...nõ..(on repetition) are l bādi/

* vowels were often substituted. For example, /a/ for / / in "coq" (rooster). He said /ka/, instead of /k k/; /e/ for /i/ in "pipe" (pipe). He said /pepe/ instead of /pip/; /e/ for /a/ in "sabot" (clog). He said /sebo/ instead of /sabo/; /u/ for /y/ and /o/ for /e/ in "durée" (duration). He said /duro/ instead of /dyre/ (more examples can be seen on appendix 1);

* simultaneous imitation, i.e., pronouncing a word exactly at the same time as I did and, and lip reading was, at times, the only way he could succeed at pronouncing correctly that word. If he had to repeat the word immediately after a successful imitation he often was unable to do that. if he was asked to repeat the same word a few minutes later he was also unable to do so, and each time he produced different errors. For example, in list (b) presented in appendix 1, there are three words (durée, tu, and clé) which are repeated twice in the list. The phonetic transcription shows that different errors were made each time that the same word was read.

1.3.2.2. Written expression

Morphological/orthographic level:

- * he had no problems in writing the alphabet on dictation;

- * he was agraphic and could not express himself in writing. During the first month after the accident, he could only write a few names of pictures or objects when they were shown to him. Often, he was unable to write anything. On other occasions, he could write the first letters of some words. When I added one more letter he sometimes could finish the word, as for instance, with the word "poisson" (fish); he wrote "poi", I added one `s', and he was able to complete the word. When prompted with the initial letter, as the `p' of "pomme" (apple), he could also finish the word. Other times, even with a prompt, he was not able to complete the word as happened for example with the word "lunettes" (glasses). He also misspelled many words, as for

instance, the word "velo" (bicycle); he omitted the letter `r' in the words "arbre" (tree), and "livre" (book). Omissions were very common even later on, when he began to write on dictation or spontaneously. He omitted letters in words like "table" (table) and wrote "tabe"; "vagabond" (wanderer) was written as "vagaonde"; "Septembre" (September) was written as "septebre". He made several substitutions; in his attempt to write the word "dimanche" (Sunday) he substituted `d' for `ch, and in the word "mercredi" (Wednesday) he substituted `o' for `r'. He also made perseverations of some letters or syllables, as for instance, the syllable `-ci' in his attempt to write the word "bicyclette" (see).

In another task, I showed him cards with different drawings and asked him to write their names. Of a total of 15 items he missed 6. But when given the written names of the same things he could recognize all the words, and he could copy the correct word under each drawing (see).

One month post-onset he could not write his address correctly. In November he still made omissions when writing his address, but copying was not impaired (see).

In order to exclude the possibility of written apraxia I used block letters and requested the patient to write individual words and short sentences which I dictated to him. It was very difficult for him to write with block letters. He found it easier to write the words on his paper pad. Of the seven words that he was asked to write, he could correctly write 4 without difficulty ("bureau", "chat", "café", "ami"), two with some difficulty ("bonjour", and "monsieur"), and he could not write one ("madame"). He wrote instead, consecutively, "mam", "mat", "mate".

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To reevaluate his writing skills on confrontation naming, seven months after the accident, I showed him pictures of objects taken from the Aachener Aphasie Test (AAT) and asked him to write the name each object. Of

12 pictures of objects he could write correctly 8, omitted the "l" in the word "table" (table), and did not remember the names of the other 3 (see).

Syntactic level

His writing was almost as impaired as his speech. He could not write sentences or even short phrases. He also exhibited agrammatisms which involved difficulties with word order. When given a set of words written on separate pieces of paper, he could not order them into meaningful sentences. Content words were better preserved than function words. In the description of the "cookie theft", he only used nouns and verbs, most of which were uninflected, although they refer to present progressive actions: jeter (to throw/splash), eaux (water), assiette (dish), chaise (chair), gateaux (cake), (il) vole (he steals), bouffe (greedy), essiyée and l'auoir. There were a few paraphasias: omission of `f' in the word "boufe", and addition of `t' in the word "jetter" (see).

In December, he was asked to describe, in writing, four pictures depicting actions extracted from the Aachener Aphasie Test. His performance was very poor. He could only write a few words, full of orthographic errors, and some of the words were not related to the pictures (see).

At the end of January he was asked to describe, also in writing, the same four action pictures extracted from the Aachener Aphasie Test. The phrases he wrote can be seen in

In January he was asked to form sentences with two given nouns. This is what he wrote:

Nouns given

Sentences created

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Je mange beaucoup. (I eat a lot.)

J'ai faim. (I am hungry.)

Nous partons en vacance. (We are leaving on holiday.)

Le médecin guérit les malades. (The doctor cures the sick.)

Il est extrêmement fatigué depuis son accident. (He is extremely tired after his accident.)

La maison dont je suis le propriétaire est située au bord de la mer.

(The house of which I am the owner is situated on the sea side.)

Semantic level

Whenever he wanted to communicate and failed to do so orally, he resorted to written language. However, this was so much impaired that it was very difficult, almost impossible to understand what he tried to say (see).

1.3.3. Receptive language

1.3.3.1. Oral comprehension

Comprehension of ordinary speech was preserved. However, he had difficulty understanding complex sentences that were long, grammatically complex, and included several ideas. For example, when giving him instructions to perform oral movements (October 1992), he did not understand some of the commands when they were just explained without demonstration. Another example is his performance in the Token Test. One hour and 40 minutes were needed to complete parts 1 through 4 of the Token Test and 45 minutes to conclude part 5. The result was 8/36. Which placed him in the lowest score for this test. He was, therefore, considered severely impaired in his oral comprehension.

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Prepositions and the verbs seemed to present difficulties, and so did colours and shapes.

We tested his comprehension skills in three of the four different languages he claimed to know well before the accident. The following simple oral commands were given to him:

raise your right hand	raise your left hand
cross your legs	clap your hands
open your mouth	close your eyes
put your right hand on the table	touch your nose with your fingers.

He was able to perform the first six commands, given in French. When given in English, he could perform only the first two; when asked to cross the legs, he stood up; when asked to clap his hands, he stood up and rose one leg, and when asked to put his right hand on the table, he rose both hands. He failed to perform any of the commands in Spanish.

His oral comprehension in English was also tested through the following activity: a paper with drawings of objects was placed in front of the patient and I called their names in English and afterwards in Spanish. He had to point at the drawing being named. The drawings were: a glass, a chair, a house, a car, and a cat.

He performed this task correctly with English names. With Spanish names, even though he was right in pointing to 4 of them, I had the impression that he was guessing. Therefore, I requested him in Spanish to perform the task again and he missed

three pictures.

At the beginning of December Said could already perform complex commands like "pick up the yellow rectangle, give me the green one and put the red one on the table"; "put the white circle over the red circle."; Put the blue circle between the red circle and the white circle". He was not able to do this when the Token test was administered to him in October.

1.3.3.2. Written comprehension

Orthographic and morphologic levels

When the letters of the alphabet were spread in front of him, and he was asked to point at each letter as I pronounced them, he did the task correctly and without any difficulty.

The Token Test was also used to test this patient's written comprehension (October 1992). For the written part each of the commands was written on a separate strip of paper and given to the patient one after another. Two sessions of 45 minutes and 60 minutes were necessary for him to complete the written comprehension test. The result was 21/36 which is equivalent to a score of 17 in the oral administration of this test. Thus, his performance in the written test was considerably better than his performance in the oral test.

He had difficulty in distinguishing shapes, and seemed to have some problems with colours. However, when he tried to concentrate, and attempted to answer a second time, he generally made the correct response.

Said had no problems with semantic categories. When given a

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series of groups of four words and asked to point at the element that did not belong to the group of words, he did so without difficulty:

- chat-livre-chien-lapin
- fourchette-couteau-cuillère-crayon
- pomme-maison-poire-raisin

When Said was asked to read some words extracted from the "Plan de L'examen clinique des aphasiques", in March 1992, even though he had difficulty in pronouncing them, he knew what each word meant. He gave synonyms for some of these words. For example, while trying to read the word "terre" (land/world) he wrote "monde" (world); when trying to read the word "dent" (tooth) he pointed at his teeth; for the word "rat" he explained by gestures what a rat is, and showed a picture of a rat.

Syntactic and Semantic levels

Said was given the following written commands which he read and performed correctly (April 1993):

Fermez les yeux. (Close your eyes.)

Ouvrez la bouche. (Open your mouth.)

Fermez la porte. (Close the door.)

Donnez-moi un verre d'eau. (Give me a glass of water.)

Faites un signe d'adieu à l'aide de votre main. (Wave goodbye with your hand.)

Donnez-moi le crayon qui est à votre droite. (Give me the pencil which is on your right.)

To test his written comprehension without requiring other linguistic skills I requested him to match the following

sentences with the corresponding pictures taken from the Aachener Aphasia Test. Said performed this tasks without any mistakes (June 1993):

Le garçon donne un morceau de viande au chien. (The boy gives a piece of meat to the dog.)

Ils se disputent. (They are quarreling.)

La femme assèche la vaisselle.(The woman dries the dishes.)

L'homme lit le journal. (The man reads the newspaper.)

La professeur écrit dans le tableau. (The teacher writes on the blackboard.)

Le mendiant demand de l'argent. (The beggar asks for money.)

Le garçon a cassé le verre. (The boy has broken the glass.)

La femme ecôrce les pommes de terre. (The woman peels the potatoes.)

Le indien attache l'homme à l'arbre. (The indian ties the man to the tree.)

L'homme pêche une botte. (The man catches a boot.)

Le police arrêtt le bandit. (The policeman arrests the thief.)

1.3.4. Numbers and calculation

There was some degree of acalculia which improved in the ensuing months. Mental and written calculations where often performed accurately, but slowly (see).

When asked his age, on various occasions he had to start counting from 1 up to 22 (his age). When he had no time to do that he would resort to writing it down.

Said was asked to write down the numbers 1 to 30. At first, he tried to say them at the same time that he was writing, but in so doing, he made semantic paraphasias, such as, saying eight as he wrote five. He realized immediately that what he had said was

not correct and exclaimed "non" (no), but he was not able to correct himself. I then instructed him not to pronounce the numbers as he wrote them and he did so correctly until number 16. While writing 16, he said nineteen. Yet, when asked to point at number 19, he did so correctly.

1.3.5. Spontaneous drawing and copying

Spontaneous drawing and copying were unimpaired (see and).

1.3.6. Colour recognition and naming

He could write correctly the names of the colours presented to him.

He was also able to perform commands such as "put the white circle over the red circle; put the blue circle between the red circle and the green circle" (see).

1.3.7. Other findings

On October 30th, a test was administered, which consisted of matching pictures that were semantically related: one of two choices should be matched to a given picture. For example, when shown a loaf of bread, the patient should select between a picture of butter or a picture of a fruit, the one that was most closely related to bread. In 60 he missed 7, and therefor, his comprehension of common things was considered unimpaired.

He had difficulty in finding among a list of written words, the words that were said to him. For instance, when asked to point at the words "fil", "chat", "bouche", "soufle", "carafe", "coq", "travail", "esprit", "augmenter" and "zèbre", written in front of him, he was able to show them only after a long time

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and after having passed the eye over them a few times. Other words, such as "esprit" "carafe", were wrongly identified. For example, when asked to point at the word "carafe" he pointed instead at the word "racle", and when asked to point at the word "esprit" he pointed at the words "exploit" and "espiègle".

It was also noticed, that Said was not always able to recognize his faulty production of words. Several times he said or read a word wrongly, stopped and he looked at me for approval. When asked whether the word had been correctly pronounced, he did not know.

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2. DISCUSSION

An analysis of this patient's speech and language characteristics was carried out using both standardized and non-standardized tests. The results revealed that this patient had a severe form of motor aphasia with recurrent utterance; his speech was severely reduced for many months and almost all communication was carried out through written fragmentary expression. There was great need for inference, questioning and guessing by the listener, and therefore, the range of information which could be exchanged was very limited. In addition, he was agraphic and his reading and speech comprehension were also slightly impaired.

There were, however, various symptoms that resembled another syndrome which is often compared, contrasted and confused with motor aphasia: speech apraxia. This patient sometimes groped in vain for a word which he knew and was even able to write down, correctly and without difficulty. The paraphasias committed by this patient also resembled those made by speech apraxics: substitutions were numerous and outnumbered omissions and distortions; he made several anticipations and perseverations, and he tended to reduce clusters. Moreover, he syllabified almost every word he pronounced. All of this lead to the supposition that he had, in addition to his motor aphasia, speech apraxia.

The symptomatology exhibited by this patient was further examined with the objective of arriving at an accurate diagnosis of his impairment.

Loss of oral-verbal expression with preservation of all other

verbal abilities, "apraxia of speech" or "verbal apraxia", is generally compared and contrasted with "Broca's aphasia" which, in addition to non-existent or sparse oral-verbal output, include agraphia and alexia. However, this comparison between speech apraxia and Broca's aphasia is a controversial issue. This controversy springs from various factors, one of them being the fact that the condition that we nowadays call "apraxia of speech" has been variously referred to by different names which often did not mean the same thing: the term "aphemia" was originally introduced by Broca (1861) to denote selective loss of articulate speech in the absence of paralysis of the oropharyngeal musculature and was used by authors such as Petit Dutailis et al. (1954) and Alajouanine et al. (1959). Others, including Jude and Trabaud (1928), used the term "anarthria", which was vindicated by Pierre Marie (1906a,b). At the beginning of this century the term "pure motor aphasia" began to be used by some authors like Mendel (1912, 1914). Still others used the terms "cortical dysarthria" or "sub-cortical motor aphasia" to refer to the isolated loss of expressive speech. Some of these aphasiologists, however, have, as Broca did, confounded two neurolinguistic syndromes, namely Speech apraxia and Broca's aphasia.

A second point of controversy concerns the role of the Broca's area in language. Some claim that the Broca's area has a purely motor function and, therefore, the result of a lesion of the Broca's area should be called anarthria (Marie, 1906 cited in Lebrun 1990). Others assign to the Broca's area a special role in the programming of speech movements and call the damage resulting from a lesion to that area apraxia (Liepmann, 1915). Finally, there are those who think that the Broca's area is

essential for the activation of response mechanisms in language, but that the deficits resulting from failure can be distinguished from arthric and apraxic disturbances, and must be properly classified as aphasic (Benson and Geschwind, 1977).

The controversy also stems from the fact that some consider apraxia of speech a variety of aphasia and not a distinct entity (Martin, 1974). Others, such as Rosenbek et al. (1989 cited in Lebrun 1990) consider that speech apraxia is different from aphasia but is frequently associated with it. Lebrun (1990) claims that apraxia of speech is a nosological entity in its own right which co-occurs with aphasia only occasionally. He recognizes the resemblances between speech apraxia and afferent motor aphasia, but also calls attention to the important differences between speech apraxia and Broca's notion of aphemias and Marie's notion of anarthria.

The description of the symptomatology of apraxia of speech offered by Lebrun (1990) and the following discussion concerning the differences between that syndrome and Broca's aphasia are of paramount importance for an accurate diagnosis and subsequent treatment of the patients who exhibit either of these two syndromes.

Lebrun's (1990) description of apraxia of speech, in addition to criteria offered by Goodglass and Kaplan (1972), Benson (1979 cited in Halpern, 1986) Davis (1983) and others, to describe Broca's aphasia, will be used to analyze the symptomatology of this patient. On the basis of this analysis it will be possible to specify the characteristic symptoms of this patient and arrive at a clear and accurate diagnosis of his condition.

2.1. Disordered articulation

Speech apraxics may, immediately after the onset, be totally unable to speak or even to utter a single sound on request, and there may be some truly aphasic deficits due to diaschisis. However, the aphasic deficits clear relatively quickly. The patient is then left with a selective impairment of speech production of which the main symptom is disordered articulation, which includes phonemic paraphasias and phonetic distortions. They do not remain inactive, they keep trying to produce the desired word, despite the difficulties, and they eventually succeed at uttering any word (Lebrun, 1990).

In Broca's aphasic patients, on the other hand, oral output may be extremely limited, and sometimes even non-existent, for many months.

The patient generally has enormous difficulties in forming words (Leonard, 1979), and there is increased effort in producing speech (Benson, 1979; Godglass and Kaplan, 1972; Nespoulous et al., 1983; and Davis, 1983). They often remain inactive when faced with the difficulties of pronouncing a given word.

The patient in this study had a severe reduction of speech which lasted for many months. He often had articulatory difficulties and groped for words which, in other occasions, he had pronounced on request, for instance, his name or his age. He would grope for a while, often without producing any sound, and sometimes producing phonemes that were not the correct ones. Finally he would resort to writing the word down.

It is a known fact that the articulatory difficulties exhibited by speech apraxics can resemble the oral expressive language behaviour of the aphasic patient. As Halpern (1986:34) states "...the phonemic groping of the apraxic patient can

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resemble the word-finding difficulty of the aphasic patient." He adds that, in case of doubt, the two disorders can easily be separated by asking the patient to write the word. If he succeeds to do so we then know that he does not have word-finding difficulties but rather articulatory difficulties. It could be claimed from this observation, that since Said knew which words he wanted to pronounce, his only problem was that he could not correctly order the positioning of speech musculature and the sequencing of muscle movements for volitional production of the sequence of phonemes that constituted the intended word. It is important to notice, however, that this behaviour was observed only on a few occasions. Speech apraxics, are able to write what they want to say almost all the time, and they do not just say isolated words, as was the case with this patient. A feasible explanation for this behaviour could be that, on certain occasions, he was not able to access the oral representation of the word he wanted to pronounce, and its written form was more easily accessible at that particular moment. If prompted with the initial sound, or the lip movement required to produce that sound, he would immediately say the word. So, it appears from all this that this patient showed characteristics of articulatory difficulties exhibited by Broca's aphasics.

Even though the above seems a plausible, and a reliable means of separating these two syndromes, there remains the need to understand better the articulatory disorders in each of them in order to achieve maximum diagnostic accuracy. We have to keep in mind that not all apraxic patients are literate and moreover, there are some who are hemiplegic and may not be able to use their preferred hand.

Since we know that the articulation of the Broca's aphasics is also disordered, and like in speech apraxia, it includes phonemic paraphasias and phonetic distortions, let us look at the quantitative and qualitative differences between the phonemic errors of speech apraxics and Broca's aphasics that there seem to exist:

1. Sequential errors are more numerous in speech apraxia than in Broca's aphasia (Shewan, 1980 and Nespoulous et al., 1983 cited in Lebrun, 1990)

This patient produced more non-sequential than sequential errors. These non-sequential errors seem to be due to articulatory groping. There also seem to be qualitative differences between the two types of groping: phonemic replacements in speech apraxics, tend to take place within a short articulatory distance. The phoneme actually uttered by the patient and the target phoneme rarely differ by more than two distinctive features (Puel et al., 1980; Washino et al., 1981 and Odell et al., 1990, cited in Lebrun, 1990). In the Broca's aphasics' speech, phonemic replacements seem to occur at random. Christensen (1972:109) says that "Lesion of the frontal lobes causes the patient's reading to be transformed into an uncontrollable pattern of guesses, random associations and perseverations."

This patient made more errors that bore no resemblance to the target sound than errors that differed by only one or two features from the target sound. Most phonemic replacements produced by him seemed to come about as random guesses. However, there was also a considerable number of phonemic replacements which tended to differ from the target sound by less than two

distinctive features. It is worth noticing that there were more errors that resembled the target sound in spontaneous speech than in reading.

2. In the speech of Broca's aphasics, perseverations outnumber anticipations (Nespoulous et al., 1973), whereas the contrary happens in the speech of apraxic patients (Alajouanine et al., 1949; Lebrun et al., 1973; LaPointe and John, 1975; Itoh and Sasanuma, 1984, cited in Lebrun, 1990). In LaPointe and John's study of the speech of 13 apraxic subjects, anticipatory errors outnumbered reiterative errors by a ratio of 6 to 1. Furthermore, anticipations, perseverations and transpositions occur both within words and across word boundaries in apraxic speech (Lebrun et al., 1973).

The speech of this patient had very few anticipations and perseverations within words. Anticipations across word boundaries never occurred, whereas perseverations across boundaries occurred often.

It seems reasonable to assume that this quantitative difference between perseverative and anticipatory errors has its origin in the nature of the deficit in each syndrome. In speech apraxia, the verbo-motor engrams are accessible, it is only their unfolding that is disturbed. As a consequence, when trying to pronounce a word or a sentence, sounds which should be pronounced later in the sequence of sounds that compose the desired word or sentence, are uttered before the sound(s) that precede them. That is to say, that their mental programming of a sentence is taking place at a normal rate. However, the motoric disturbance leads the patient to anticipate some sounds which are already mentally represented and sequenced. In Broca's

aphasics, on the other hand, because the verbo-motor engrams are not accessible, two things may happen. What the patient has just pronounced remains in memory and does not allow the mental representation of the following sound or word to come to memory. Therefore, the perseveration occurs. There may be an alternative explanation: the engramme for the following sound or word is not accessible. What has just been said and is still in short term memory, is easily accessible and crops up in the form of perseverations.

3. In apraxic speech substitutions predominate over other types of phonemic paraphasias (Johns and Darley, 1970, cited in Martory, 1983; La Pointe, 1969; LaPointe and Johns, 1975; Wertz, LaPointe and Rosenbek, 1984,). All 13 subjects in LaPointe and Johns' study (LaPointe and Johns, 1975) produced some sequential errors, but the percentage of such errors relative to the total number of substitution and initiation errors was small (7 %). Martory et al. (1983) found that both in Broca's aphasia and in apraxia of speech substitutions predominated.

The patient in this study also produced more substitutions than any of the other phonemic errors. Thus, this does not seem to be a reliable criterion for differentiating the two syndromes.

4. Metathesis of phonemes occur rarely in the speech of apraxics (LaPointe and Johns, 1975). In the speech of Broca's aphasics there are often transposition of phonemes as in "pelsin" for "pencil" (Goodglass and Kaplan, 1972).

This patient produced very few metathesis in his spontaneous speech as well as in his readings and repetitions. This is also

a symptom that occurs in both syndromes. Its frequency of occurrence is very limited. Therefore, it does not seem to be a reliable criterion to differentiate the two syndromes.

5. In speech apraxia the percentage of errors generally increases with word length (Lebrun, 1976; Sasanuma, 1971; Deal and Darley, 1972; Wertz, LaPointe and Rosenbek, 1984). This does not seem to be necessarily the case in Broca's aphasia. Nespoulous et al., (1983), for instance, found that Broca's aphasics made proportionally more errors in mono- than in polysyllabic items when repeating isolated words.

The patient in this study had as much difficulty with monosyllabic words as he had with longer words. Speech apraxics, despite the enormous difficulties, succeed at pronouncing any word of any length (Lebrun, 1990). Broca's aphasics, on the contrary, when faced with a polysyllabic word, are often inactive (Leonard, 1979). It may be that the reason for less errors in poly- than in monosyllabic words is that they do not actually read them.

6. Omissions, especially in consonant clusters, are practiced by both groups. The occurrence of this phonemic paraphasia does not seem to be considerably different between these two groups. Thus, the fact that this patient omitted sounds does not allow me to place him within either one of these two syndromes on the basis of this symptom.
7. Creation of consonantal clusters has been reported as a symptom of speech apraxia (Kent and Rosenbek, 1983, and Shankweiler and Harris, 1966, cited in Lebrun, 1990). Unfortunately, not much has been said about this kind of phonemic distortion in the

speech of Broca's aphasics. This patient often created clusters, tending to privilege the cluster /tR/.

8. Insertion of a schwa between the cluster constituents or at the end of the word is also done by apraxics (Lebrun et al., 1973; Alajouanine et al., 1939 and 1949; Kent and Rosenbek, 1983). Nothing seems to have been reported concerning this aspect in the speech of Broca's aphasics.

This patient tended to insert a schwa at the end of words; the words /nanan / ("banane"), /t tR / ("tête"), /dimādR / ("dimanche"), /dokt R/ ("docteur") are just some examples. He also, but less often, inserted schwas between cluster constituents as in /med t / or /m Rd s / ("médecin"), and /ta R / ("tâche").

9. The output of speech apraxics contains abnormal vowel formation (Lebrun et al., 1973; Alajouanine et al., 1939; Kent and Rosenbek, 1983). Nevertheless, vowels evoke fewer errors than singleton consonants (Wertz, Lapointe, and Rosenbek, 1984). In the study by Cardebat et al. (1983), they found that the vocalic system was stable both in the apraxic and in the aphasic patients. The errors were almost exclusively committed in the consonantal system. Ryalls (1987:23) says "A longstanding observation in aphasia is that consonant phonemes are more subject to phonemic paraphasias than are vowel phonemes". These findings lead to the conclusion that this symptom can not be considered a reliable criterion for differentiation between the syndromes of apraxia of speech and Broca's aphasia. In both syndromes the symptom manifests itself in a very similar way.

The patient of this study did indeed exhibit vowel errors, but

those were much fewer than the consonantal errors.

10. Unpredictability of articulatory errors is a characteristic of the output of speech apraxics (Sasanuma, 1971, cited in Lebrun, 1990; Lebrun, 1990). This aspect of Broca's aphasics output has not, to my knowledge, been mentioned in the literature.

It is plausible that, since perseverations prevail in the speech of Broca's aphasics, after an aphasic patient has uttered a word or a sound, the word or sound that will follow can be predicted.

Indeed, this is what often happened in the speech output of this patient. With monosyllabic words, he would repeat the whole word, but with bi- or trissyllabic words, he tended to repeat the last syllable of the previous word. For example, after saying /m d s /, he repeated the syllable /s / a number of times before succeeding to pronounce the next word. When saying the days of the week, which in French all except one end in /di/, he repeated the syllable /di/ several times before being able to say the next word.

However, when reading, his errors where unpredictable. This patient pronounced the same word correctly at one moment and distorted it a few seconds later. Sometimes he mispronounced the word twice, and the errors were different every time. All phonemes were equally liable to be replaced, deleted or distorted.

11. There seems to be no agreement concerning the misarticulation of initial consonants by speech apraxics. Some authors (Hecean, 1972; Shankweiler and Harris, 1966; Trost and Canter, 1974, cited in Halpern, 1986) say that initial consonants tend to be

misarticulated more often than consonant phonemes in other positions. However, Martory et al. (1983) say that speech apraxics make significantly more errors in final position than in initial position. Johns and Darley (1970, cited in Martory, 1983) reported that no single position in the word emerged as characteristically more difficult. LaPointe and Johns (1975) found error percentages for initial, medial, and final positions to be nearly equal. Dunlop and Marquart (1977, cited in Halpern, 1986) found phoneme position unrelated to occurrence of error. Klich, Ireland and Weidner (1979, cited in Halpern, 1986) found that more substitutions were made in the initial word position. Wertz, LaPointe and Rosenbek (1984) concluded that in speech apraxics, sound position in a word may or may not have an influence on whether it will be produced accurately. Several authors (Goodglass and Kaplan, 1972; Mohr, 1976; Kerschensteiner et al., 1975; Reinvang, 1985) claim that Broca's aphasics's speech is produced with hesitations and effort, particularly in initiation.

This patient tended to articulate correctly the initial sounds (both vowels and consonants), but they were often the only correct sounds (see appendix 1). The consistency with which this patient produced the initial sounds correctly is striking. Therefore, this aspect deserves further research.

12. Speech apraxics are impaired in all kinds of oral-verbal activities, i.e., the severity of their condition remain the same, whether they hold a conversation, read aloud, recite series they know by rote, or repeat words (Alajouanine et al., 1949; Pilch and Hemmer, 1970; Nebes, 1975; Lebrun, 1976; Puel et al., 1980; Wahsino et al., 1981; Puel et al., 1984; Yousef-Bak

et al, 1984 all cited in Lebrun, 1990). Singing (Nebes 1975 cited in Lebrun 1990) and cursing (Schiff et al., 1983, cited in Lebrun, 1990) are also impaired. These findings run counter to the findings of Wertz, LaPointe, and Rosenbek (1984) who found imitation to be better than spontaneous speech in speech apraxics.

In Broca's aphasia, output difficulties often vary with the type of expressive activity (Nespoulous et al., 1983; Lebrun, 1976; Levine and Mohr, 1979, cited in Lebrun 1990). Goodglass and Kaplan (1972) say that the articulatory difficulty is much reduced in imitation and may disappear in the recitation of memorized series.

This patient's repetition, even though impaired, was better than his spontaneous speech. That is in accordance with the symptoms of Broca's aphasia, and with the findings by Martory et al. (1983) that in Broca's aphasia there are more errors in reading than in repetition. However, in this case there was no production of expletives nor could he sing or recite automatized series.

13. In Broca's aphasics the paraphasia pattern might show some literal paraphasia, but few of the other varieties (Goodglass and Kaplan, 1972) However, this patient showed some semantic paraphasias. I consider this a symptom of Broca's aphasia since the central language processing is impaired and not the motoric programming as is the case in apraxia of speech.

2.2. Anomia

Naming is grossly impaired in Broca's aphasics (Goodglass and Kaplan, 1972; Leonard, 1979). At the beginning of the recovery

stage object-naming often returns to functional levels. In speech apraxics naming is unimpaired. This patient had anomia which improved gradually as he recovered. Eight months post-onset he still showed a slight degree of anomia. This is clearly a sign of a language problem, thus of Broca's aphasia rather than of speech apraxia.

2.3. Reduced speech rate

Speech apraxics show reduced speech rate. Their speech sounds tend to be protracted, especially in long words (Alajouanine et al., 1939; Alajouanine et al., 1949; Shankweiler and Harris, 1966; Lebrun et al., 1973; Kent and Rosenbek, 1983; Collins et al., 1983; Odell et al., 1990, all cited in Lebrun, 1990). Broca's aphasics show decreased output (50 words per minute or less and often fewer than 10 words per minute) (Benson, 1979; Davis, 1983). There is a qualitative difference between the two. In the output of speech apraxics all the intended words are said. It just takes longer than it would take normal individuals. Speech apraxics speak slowly in an attempt to control their mistakes. In the output of Broca's aphasics, on the contrary, there are many silences in between the words. They stop to think of a word that often is not accessible; they try to find other words or they may get stuck.

In this patient it is not possible to judge this aspect of his speech since he only said sporadically a few isolated words.

2.4. Decreased phrase length

Broca's aphasics show decreased phrase length (fewer than 4 words and often only single words) (Benson, 1979 and Davis, 1983); The patient may have only one- or two-word sentences

(Goodglass and Kaplan, 1972). Speech apraxics, on the other hand, produce sentences of any length. They may try to reduce the length of their sentences in trying to reduce the burden of the articulatory difficulties. This is very different from the difficulties of the Broca's aphasics, who produced shorter sentences due to the fact that they do not remember the words, and they no longer use function words.

This aspect could best be seen in this patients writing. His phrases and sentences generally had less than three words.

2.5. Verbal stereotypy and automatic series

Broca's aphasics often have a verbal stereotypy, and retain automatic series. Speech apraxics do not show any stereotypies and they can remember automatic series. Their only problem is that in saying these automatic series their speech may be as disordered as their spontaneous speech.

The patient in this study produced a stereotypy almost every time that he attempted to speak. However, his production of automatic series was impaired.

2.6. Intensity variation

Speech apraxics show reduced intensity variation across syllables. their syllables tend to be isochronous and to have equal prominence (Lebrun et al., 1973; Kent and Rosenbek 1982, 1983 cited in Lebrun, 1990).

This patient maintained a normal intensity variation across syllables. There was a clear difference between stressed and unstressed syllables, even when he failed to pronounce the correct phonemes.

2.7. Scanning speech

Speech apraxics tend to produce scanning speech. Their delivery shows a number of intersyllabic interruptions (Lebrun, 1990). Broca's aphasics, on the other hand, may pause between syllables, but the pattern is irregular. Sometimes, they pause between every syllable, and other times they pause after the second or the third syllable (Lebrun, personal communication).

This patient syllabified almost every word he said, read or repeated. However, there were a few times in which he paused after the first syllable and produced the second and third syllables without pausing in between.

2.8. Audibility

The oral-verbal output of speech apraxics is generally quite audible. Their voices are not muffled and their articulators are not hypokinetic (Lebrun, 1990; Puel et al., 1980). There is little undershoot in the articulation of speech apraxics. The individual articulatory gestures of speech apraxics are often normal, except for their duration (Hardcastle, 1987, cited in Lebrun, 1990). I found no data reporting this acoustic aspect in the speech of Broca's aphasics.

The speech of this patient was perfectly audible. I was always able to identify the speech sounds produced by him even though they were often incorrect.

2.9. Agraphia and alexia

In speech apraxics, most of the time, other linguistic abilities are impaired at the same time. This impairment is slight in comparison with the articulatory disorder and is not intrinsic to it. They may occasionally omit a word in writing.

Others may need more time to write than before the onset of the apraxia (Alajouanine et al., 1949). They tend to omit function words in writing (Nebes, 1975 cited in Lebrun, 1990). They may read more slowly than before the onset of the speech apraxia (Itoh et al., 1979 cited Lebrun, 1990). In Broca's aphasics, there is also impairment of other linguistic abilities. Their writing is as impaired as their speech (Halpern, 1986). The patient may have only one- or two-word sentences and show his maximum difficulty in combining subject and verb, so that subject-noun phrase and verb phrase are produced as separate utterances. Moreover, verbs are often uninflected (Goodglass and Kaplan, 1972).

So, there seems to be a considerable quantitative difference between the verbal deficits exhibited by each group.

This patient had a severe impairment of his writing skills. His agraphia clearly resembles the writing impairment of Broca's aphasics.

2.10. Oral and written comprehension

In Broca's aphasics, auditory (listening) and visual (reading) comprehension are better than speaking and writing, yet are also impaired (Halpern, 1986). Speech apraxics, on the other hand, show none or little impairment in any of these skills (Lebrun, 1990).

This patient did show disturbances in his speech and reading comprehension, reading being more impaired than listening.

2.11. Oral apraxia

Speech apraxics frequently have oral apraxia. When speech

apraxia and oral apraxia co-occur, they are relatively independent of each other, as one may disappear while the other remains (Tissot et al., 1970 cited in Martory, 1983; Lebrun, 1976; Schiff et al., 1983 cited in Lebrun, 1990). Broca's aphasics often have oral apraxia too (Goodglass and Kaplan, 1972).

This patient had oral apraxia which gradually subsided.

2.11. Ability to recognize own errors

Speech apraxics retain their knowledge of the phonological structure of words and are generally able to recognize their errors, i.e. to discriminate between correct and faulty production of words. If they are literate, they can call up mental representations of words and divide these words into syllables and into phonemic constituents. They can operate with these constituents (Lebrun, 1976; Nebes, 1975 cited in Lebrun 1990). Broca's aphasics can not do this. They no longer know how the target word should sound. They show awareness of impairment and, as a result, frustration (Benson, 1979 and Davis, 1983). They can not call up mental representations of words.

The patient in this study often showed frustration for not being able to utter the desired words. Nevertheless, he was not always able to realize that the word he had pronounced was not correct.

Since the site of lesion in both Broca's aphasics and speech apraxics almost always lies close to the third frontal convolution, it is impossible to separate the two syndromes on the basis of anatomical findings. This patient, for example, has suffered an extensive lesion, which included the frontal and the

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parietal lobes in the left hemisphere. Both of these lobes have been cited in the literature as sites of lesions in patients who have been diagnosed both as speech apraxics and as Broca's aphasics (Square-Storer et al., 1988; Puel et al., 1984; Kushner et al., 1987, all three cited in Lebrun, 1990; Conrade, 1948; Leonard, 1979). Thus, it was only on the basis of careful neurolinguistic observation of the symptomatology exhibited by this patient that I was able to arrive at the conclusion that this is not a programming or transmissive problem, but rather a linguistic disturbance, i.e., Broca's aphasia. In this case speech output was reduced to a stereotypy for several months, he was agraphic and alexic, and his groping characteristics differed from those of speech apraxics.

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3. CONCLUSION

Even though disordered articulation is commonly agreed to be an essential aspect of Broca's aphasia, very few authors have described the nature and characteristics of this "awkward articulation". Moreover, some of these authors, who have studied consonant production deficits in aphasia, have considered that "the articulatory disorder of Broca's aphasia corresponds roughly to the impairment known as apraxia of speech" (Blumstein and Baum, 1987:7). In many other studies too, the characteristics of the speech of patients diagnosed as Broca's aphasics and of those with apraxia of speech have been, for the most part, indistinguishable. The drawback of this stance is evident: in a study like the present one it is almost impossible to refer to the existing literature concerning the output difficulties in Broca's aphasia, and make accurate comparisons between the findings obtained.

A more detailed description of the types of disfluency in both apraxic and aphasic patients is needed. In both syndromes the same linguistic aspects should be compared and contrasted. A reliable list of criteria would be one in which the symptoms exhibited in each syndrome are compared at the same level of speech, i.e., at the phonetic level, at the phonological level, at the morpho-syntactic level, and at the semantic level. Moreover, the linguistic aspects being compared should arise from identical tasks (e.g. spontaneous speech, repetition, reading).

Clinicians, neurolinguists, and speech and language therapists are often confronted with patients who are diagnosed as Broca's aphasics, and who also evidence articulatory distortions and

groping characteristics, which, at first, resemble the groping characteristics of speech apraxics. Unfortunately, they have not yet learned to look at the differences between these two syndromes because they have been predisposed to believe that apraxia of speech is a component of Broca's aphasia, or that speech apraxia does not exist as a syndrome in its own right. Only by studying these two syndromes separately are we able to contrast the symptoms of each with clarity and make accurate diagnoses. This study demonstrates that a clear understanding of the nature of each of these two syndromes and careful neurolinguistic observation of the symptoms, will lead to a reliable diagnosis and consequently, to appropriate therapy.

It seems reasonable to claim, on the basis of findings in studies that have kept these two syndromes separate (Alajouanine et al., 1949; Lebrun, 1973; Nespoulus et al., 1983; Shewan, 1980 cited in Lebrun, 1990) and in the present study, that the following seven criteria of differentiation between Broca's aphasia and apraxia of speech are reliable:

1. Speech apraxia affects purposive speech movements, i.e., groping for the exact word one wants to say but failing to pronounce it. Broca's aphasics may **occasionally** be able to write the word they want to say but fail to pronounce it. If the patient is literate and can not always, or almost never, write what he or she wants to say then it can be assumed that he is aphasic rather than apraxic.
2. Sequential errors are more numerous than non-sequential errors in speech apraxics than in Broca's aphasics.

3. Anticipations are more numerous than perseverations in speech apraxics than in Broca's aphasics.

4. Phonemic prompting (auditory stimuli) and lip movements (visual stimuli) often help Broca's aphasics (Leleux and Lebrun, 1979), including this patient, to pronounce the rest of the word correctly. Speech apraxics do not seem to benefit from phonetic prompting.

However, it is not all the time that prompting helps. Why doesn't prompting help all the time ? In what circumstances does it help ? these are questions that must be addressed in later studies for a better understanding of this characteristic of aphasic patients.

4. Speech apraxics, soon after the onset of the disease, begin to speak. Broca's aphasics may remain speechless or with very limited speech for many months.

5. During the "phase d'etat" the speech apraxics are able to read and express themselves in writing, if they are literate. Broca's aphasics exhibit lasting agraphia and alexia.

6. Speech apraxics have no problem of comprehension. Broca's aphasics have comprehension problems that are generally less severe than their expressive problems.

7. Speech apraxics are neither mute nor is their oral expression reduced to a stereotypy, as is often the case in Broca's aphasia.

Other symptoms found in each of these two syndromes are only tendencies exhibited by both groups or have not yet been thoroughly studied, and remain difficult to be used with reliability for differential diagnoses. They include presence of initiation errors, more substitution errors than combined omission and distortion errors, presence of islands of error-free production, reduction and omission of consonantal clusters, syllabification, and intensity variation.

Finally, it should be emphasized that the articulatory difficulties exhibited by each group are not of the same nature, even though the exteriorisation may be the same. There may be overlapping or similar language symptoms, but they require different approaches to therapy. The need to place the symptoms within a properly diagnosed syndrome is evident.

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APPENDIX 1

(a) 7th April. Phonetic transcription of Said's reading and repetition of mono-, bi- and trissyllabic words extracted from the "Plan de L'examen clinique des aphasiques" used in the Centre du langage de l'hôpital de la Salpêtrière:

"rat" (mouse) --- could not read it. Repeated correctly.

"fil" (yarn) --- /fo...fa...fa...wo...vo...va/. Repeated correctly.

"gare" (station) --- /ga...võ/. Repeated correctly.

"travail" (work) --- could not pronounce it.

"spetacle" (show) --- could not read it, but repeated ---
/setakl/ "professeur" (teacher) ---

/pofesa...fRof...pRos...pRofe...s R /

"terre" (world) --- /tetR /

"docteur" (doctor) --- /dokt R /

"tâche" (task) --- /ta R /

"médecin" (doctor) --- /meRd s /

"maison" (house) --- /mesõ/

"je" (I) --- / /

"jeu" (game) --- / a/

"Espagne" (Spain) --- /esam /

(b) May 13th. Transcription of Said's reading and repetition of the following list of mono- and bisyllabic words extracted from the "protocole d'examen "phonetique-phonémique" by A.R. Lecours (1969):

reading

repetition

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doigt: /or...nō...dRua...tRua/ /dua/
 clé: /kle/
 tasse: /ta...tas /
 femme: /m f /
 chat: /Sa/
 mouton: /butō..b../ /mutō/
 chèvre: /...S ...S vl / /S vR /

(c) Said's reading and repetition of the days of the week:

Lundi (Monday): /ni...nō...n ... (I prompted with /l /)...n
 di...n di (I said the whole word /l di/)...n di/

Mardi (Tuesday): /m R...m R-di... (I said /maRdi/)...maRdi/

Mercredi (Wednesday): /m R...di... (I said /m rkR di/)...m R-d
 -di... (I said /m RkR di/ and repeated the correct word)...m R-kR
 -di... (I asked him to repeat once again)...m R-d -di...m R-m R-t
 -di/

Jeudi (Thursday): /di...nō...di...di... (I gave him the prompt /
 /)...l -di (I said the whole word / di/)... di/

Vendredi (Friday): (he could not initiate the next word, so I
 read it first, and he repeated /vā-dR -di/ (I asked him to
 repeat once again and he did so correctly at a normal speech
 rate).

Samedi (Saturday): /di...di...di...nō... (I read the whole word
 /sam di/).../sa-m -di... (I asked him to repeat one more
 time)...p -ta...nō...ti...nō... (I read it again and he repeated
 correctly).

Dimanche (Sunday): /di..di-mā-dR (I said /dimā /)...di-tā- (I
 asked him to repeat)...di-dā-tR ...di-mā-tR (I read it and he
 repeated correctly).