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Assessment of Oral Language Retrieval in Broca's Aphasia Resulting from Cerebrovascular Accident (CVA)

(A Comparative Study Between Two Linguistically Treated Cases: One with Ischemic Cerebrovascular Accident (Ischemic CVA) and One with Hemorrhagic Cerebrovascular Accident (Hemorrhagic CVA))

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Abstract:

This study aims to identify the difference in oral language retrieval (oral comprehension / oral production) in Broca's aphasia resulting from a hemorrhagic cerebrovascular accident and Broca's aphasia resulting from an ischemic cerebrovascular accident. The study sample was intentionally selected and consisted of two cases that underwent orthophonic care. To achieve the study's objectives, the case study method was adopted, and the following tools were used: observation grid, interview questionnaire, and the MTA test. The results of the study, based on descriptive statistics, showed that oral language retrieval (oral production / oral comprehension) in Broca's aphasia resulting from a hemorrhagic cerebrovascular accident was better compared to Broca's aphasia resulting from an ischemic cerebrovascular accident.

Keywords: hemorrhagic cerebrovascular accident, ischemic cerebrovascular accident, Broca's aphasia, oral language, language retrieval, oral comprehension, oral production.

Introduction / Problematic:

Language is the only means through which the need for communication with others can be fulfilled. It is also a human faculty specific to the human brain, manifested through the use of a system of signs, whether oral (auditory) or written (visual) (Kahlaoui & Ansaldo, 2008). Interest in understanding the relationship between language and the brain began centuries ago but increased significantly in the late eighteenth and early nineteenth centuries with the development of phrenology and the emergence of the research of Broca and Wernicke (Ardila et al., 2015), which demonstrated that the processing of oral language is linked to two essential areas in the left hemisphere: the inferior frontal area (BA: 44–45), called Broca's area, responsible for language production (expression), and the superior temporal area (BA: 21–22),

called Wernicke's area, responsible for comprehension (reception), with these two areas connected by the arcuate fasciculus. Advances in functional neuroimaging techniques reinforced the understanding of the regions involved in linguistic activity, proving that language is not related to certain brain centers only, but rather is the result of simultaneous activity in the cerebral cortex, subcortical nuclei, and many pathways linking these areas. However, this does not negate that right-handed individuals largely rely on language areas in the left hemisphere (Hagoort, 2017).

A person may suffer a brain injury, among the most common being cerebrovascular accidents (CVA), which affect all age groups but are more prevalent among the elderly. The World Health Organization defines it as: "The rapid development of local or global signs of brain dysfunction lasting more than 24 hours." It is the leading cause of physical disability, the second cause of dementia, and the third cause of death (Diouf et al., 2005, p. 101). It is divided into two types: ischemic CVA, which results from blockage of cerebral arteries or veins and represents 80% of cases (Ben Elifawi, 2021); and hemorrhagic CVA, which occurs due to rupture of a blood vessel leading to brain hemorrhage and represents 20% of cases (Paulim et al., 2018).

Cerebrovascular accidents are among the main causes of aphasia, defined as the partial or complete loss of the ability to communicate. The patient experiences difficulty in speaking, naming objects, and/or understanding others' speech, reading, and writing (Shlaug et al., 2008). Séniow et al. (2009) stated that about one-third of the world's population experiences aphasia in the early stages of cerebrovascular accidents. However, aphasia cannot be considered an inevitable result of these accidents, since its occurrence depends mainly on the affected regions. Antonio and Damasio (1992) confirmed that injury to language areas is a necessary condition for aphasia, which is divided into two main types: fluent aphasia and non-fluent aphasia. Broca's aphasia (aphasie de Broca) is the most common type of non-fluent aphasia. Choual Nassira defined it as a type of aphasia that affects verbal production while preserving the ability to understand others' speech. In most cases, the patient suffers from stereotypy, morpho-syntactic disorder, and difficulty naming objects. Thus, in Broca's aphasia, the problem relates to the motor production stage of language in the brain, not the comprehension stage (Choual, 2019). Antonio and Damasio (1999) noted that Broca's aphasia is not limited to Broca's area (the left third frontal gyrus) but also includes surrounding anterior areas (Brodmann areas 06, 08, 09, 10, 46), white matter, and basal ganglia. However, injury in these regions does not necessarily mean the persistence of Broca's aphasia symptoms, since the nervous system is characterized by the ability to reorganize and adapt, known as neural plasticity. This term was

first used by William James over a century ago in his book *Principles of Psychology* (1980). Borrowed from the physical sciences, where a piece of metal can be bent into a different shape, James hypothesized that similar changes could occur in the nervous system (Warraich et al., 2010), allowing Broca's aphasia patients to partially retrieve lost language. This retrieval is of two types: spontaneous recovery, occurring in rare cases with complete recovery within hours or days after the injury (Olivier, S.A.), as Pedersen et al. (1985) showed that this type can be observed in the first and second week after cerebrovascular accidents; and recovery through orthophonic care, achieved after undergoing language rehabilitation. Mazzoni et al. (1995) demonstrated a difference in oral and written expression recovery between groups receiving linguistic intervention and those who did not. Similarly, Schlaug et al. (2008) confirmed the recovery of the ability to describe complex images, repeat syllables and sentences, and name objects in two Broca's aphasia cases after melodic intonation therapy.

In addition to the impact of orthophonic care on language recovery, there are other factors. Plowman et al. (2011) classified them into neurological factors (injury location and severity) and individual factors (age, sex, laterality, education level, social, economic, and psychological status). They noted a complex interaction between these factors, with neurological ones having the greatest impact, especially on long-term recovery. Welson and Fridrikson stated that the type of CVA is an important factor in predicting recovery, due to the different pathophysiology of ischemic versus hemorrhagic types (Vera, 2008). In hemorrhagic CVA, microglial cells are activated at the injury site, absorbing the hematoma and edema, reducing neural tissue damage linked to diffuse hemorrhage, and enhancing axonal repair (white matter) (Chen et al., 2021). In ischemic CVA, thrombus formation or embolism at the vessel level leads to blood supply interruption and neuronal death within minutes in the affected area. However, although neural tissue is functionally impaired, collateral circulation may provide alternative blood supply (Werner et al., 2003).

Based on the above, the following questions can be posed:

- Is there a difference in oral language retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident?
- Is there a difference in oral production retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident?
- Is there a difference in oral comprehension retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident?

Study Hypotheses:

- General hypothesis: There is a difference in oral language retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.
- First sub-hypothesis: There is a difference in oral production retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.
- Second sub-hypothesis: There is a difference in oral comprehension retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.

Study Objectives:

- To identify the difference in oral language retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.
- To identify the difference in oral production retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.
- To identify the difference in oral comprehension retrieval in Broca's aphasia resulting from ischemic versus hemorrhagic cerebrovascular accident.

Operational Definitions:

- Oral language retrieval: The score obtained by the two study cases on oral language items (oral production / oral comprehension) of the MTA test after receiving orthophonic care.
- Broca's aphasia resulting from ischemic cerebrovascular accident: A woman who suffered an ischemic CVA in the temporo-parietal lobe, leading to a diagnosis of Broca's aphasia.
- Broca's aphasia resulting from hemorrhagic cerebrovascular accident: A woman who suffered a hemorrhagic CVA in the fronto-temporo-parietal lobe, leading to a diagnosis of Broca's aphasia.

Field Study:

1. **Study Method:** This study used the case study method, as it allows for considering the two cases as unique in their characteristics and behaviors. Although case study results cannot be generalized, it remains the appropriate method in neuropsychological studies (Bouridah, 2013, p. 113). Thus, it is suitable for this study as it enables access to accurate and detailed data regarding the case, its history, condition, and circumstances, allowing for understanding and evaluating its language retrieval.
2. **Study Limits:**

- Temporal limits: The study extended from 12/03/2023 to 23/05/2023.

- Spatial limits: The study was conducted at the specialized rehabilitation and functional adaptation hospital "El Eid Dahoui," Ras El Ma, Setif, and at the Aichouch Khawla Clinic for motor rehabilitation and physiotherapy, M'sila province (Maqqara).

3. **Study Sample:** The study included two cases selected from 15, intentionally chosen according to the following criteria: same gender, same laterality, both experiencing CVA for the first time, similar age, diagnosed with Broca's aphasia, comparable injury severity and duration of orthophonic care, similar linguistic symptoms at the start of care, similar educational level, similar degree of bilingualism, with the only difference being the type of CVA causing aphasia. Health, psychological, and economic factors were also considered. The information that helped determine these influencing factors was obtained through interviews with the two orthophonists treating the cases. The following table presents the characteristics of the two study cases:

Case Data

Table 1. Characteristics of the Two Cases

Variable	Case (M.H) Ischemic Stroke	Case (L.T) Hemorrhagic Stroke
Gender	Female	Female
Age	49 years	51 years
Laterality	Right-handed	Right-handed
Type of Stroke	Ischemic Stroke	Hemorrhagic Stroke
Cause of Stroke	High blood pressure	High blood pressure
Previous Stroke	No, first time	No, first time
Lesion Area & Severity	Left temporo-parietal porencephalic cavity related to old ischemic lesion	Deep left fronto-temporo-parietal hematoma
Languages Before Stroke	Arabic / French	Arabic / French
Most Used Language	Msila dialect	Constantine dialect
Educational Level	Third year of secondary school	University
Profession	Member of Municipal People's Council + Association activist	Nurse
Type of Aphasia	Broca's aphasia	Broca's aphasia
Language Symptoms	Mutism	Mutism
Psychological Aspect Immediately After Stroke	Depression and rejection of illness	Depression and rejection of illness

Variable	Case (M.H) Ischemic Stroke	Case (L.T) Hemorrhagic Stroke
Other Diseases	No	No
Duration of Speech Therapy	10 months	7 months
Start of Speech Therapy	One month after stroke	Seven months after stroke
Continuity of Speech Therapy	3 continuous months (Ras El Ma), then interruption, then 1 month in private clinic, then interruption, then 5 continuous months	Continuous
Place of Speech Therapy	Aïchouche Khawla Clinic for Motor Rehabilitation and Physiotherapy, Maqra (Msila)	Specialized Hospital for Rehabilitation and Functional Adaptation, Ras El Ma (Setif)
Economic Level	Medium	Medium
Social Status	Married (mother of 5 children)	Married (mother of 4 children)

Study Tools

Observation

- Direct observation: A structured observation grid was built based on Broca's aphasia symptoms mentioned in theoretical heritage and previous studies.
- The grid included: verbal (expressive/receptive), non-verbal, cognitive, and psychological aspects.
- Each symptom was rated across 5 alternatives: *present, absent, slightly present, strongly present, sometimes present*.
- Allowed monitoring Broca's aphasic behavior from all perspectives, forming a simple picture of linguistic, cognitive, and psychological levels of both cases.
- Indirect observation: reviewing medical files of both cases, providing information on history, type, cause, area, and severity of stroke.

Interview

- Case 1: Direct interview (face-to-face) with speech therapist.
- Case 2: Direct interview with husband + speech therapist.
- Gathered data on medical history, conditions, symptoms at onset, rehabilitation methods/duration, and asked:

  Which has better linguistic recovery: Broca's aphasia due to hemorrhagic stroke or due to ischemic stroke?

Language Test

- Applied the **MTA test**, originally the MT 86 battery (*Protocole Montréal–Toulouse d'examen linguistique de l'aphasie*).
- Includes ML Alpha & Beta, created by a Franco-Canadian multidisciplinary team (18 members: linguistics, speech therapy, psychology, neurology).
- Adapted and standardized to Algerian socio-cultural and psycholinguistic context by **University of Algiers & Toulouse le Mirail University**.
- Example of adaptation: replacing *pineapple* with *dates*.
- Validated on 460 Algerian adults (ages 20–70, mono-, bi-, and multilingual). Achieved success rate >85%.
- Algerian multilingual version published in 2000.
- Contents: casebook, guidebook, cassette tape, and test book.
- Tests include:
    - **Oral Expression:** directed dialogue, spontaneous speech, grammatical residues, repetition of syllables/words/non-words, oral naming, storytelling, comprehension of words/sentences.
    - **Written Expression:** reading words/sentences, reading & comprehension of text, reading numbers, written comprehension, spelling, written expression.
    - **Apraxia & Gnosia:** oral-facial apraxia, ideomotor apraxia, color gnosia, auditory gnosia, letter/word recognition, body-part identification.
- In this study, all test items were applied except writing by dictation/copy (due to right hemiplegia).

Results and Analysis

A/ Case 1 (Hemorrhagic Stroke) – Observation Results

Table (2): Results of the Observation Grid for Case 1 (Hemorrhagic Stroke)

Exists	Does Not Exist	Exists Little	Exists A Lot	Exists Sometimes	Indicators	Dimensions	Aspects
	X				Mutism	Difficulty in accessing the mental lexicon	Verbal–Expressive Aspect
X					Word-finding deficit		

Exists	Does Not Exist	Exists Little	Exists A Lot	Exists Sometimes	Indicators	Dimensions	Aspects
	X				Phonemic paraphasia		
		X			Semantic paraphasia		
X					Neologisms		
	X				Long time to reach target word		
			X		Complete inability to reach target word		
	X				Religious phrases when unable to reach target word		
	X				Irregular speech flow		
X					Phonetic disintegration		
			X		Shortening syllables and words		
X					Fixed verbal expression	Stereotypy	
			X		Repetition of previous response to later instruction	Perseveration	
X					Easily uttering words of thanks and greetings	Automatic–voluntary dissociation	
X					Easily repeating religious phrases		
X					Correct words during spontaneous speech		
			X		Quantitative and qualitative reduction in speech	Speech reduction	
X					Silent moments		

Exists	Does Not Exist	Exists Little	Exists A Lot	Exists Sometimes	Indicators	Dimensions	Aspects
	X				Few and incomprehensible words		
			X		Desire not to continue speaking		
			X		Expressing a sentence with a single word	Agrammatism	
					Not observable – case has not reached sentence production	Mixing the three tenses of the verb	
					Substituting verbs with nouns		
					Omitting connectors and pronouns		
					Great effort linking sentence units		
X					Incomprehensible sentences		
	X				Monotonous speech	Rhythm–intonation disorder	
			X		Robotic speech		
X					Desire to converse and convey ideas	Desire & participation in dialogue	
			X		Responds only to questions		
	X				Eye contact		
	X				Naming pictures	Word comprehension	Oral comprehension
			X		Understanding simple sentences	Sentence comprehension	
			X		Understanding complex sentences		

Exists	Does Not Exist	Exists Little	Exists A Lot	Exists Sometimes	Indicators	Dimensions	Aspects
	X				Requests examiner to repeat instruction		
			X		Slow, labored, involuntary movements during speech	Movements, gestures, signals	Non-verbal aspect
	X				Facial expressions and gestures		
	X				Use of pointing		
			X		Susceptibility to distraction	Attention	Cognitive aspect
			X		Sustaining attention		
			X		Appears absent, inattentive to examiner		
			X		Executes instruction before examiner finishes		
			X		Impulsivity in answering		
			X		Interrupts examiner's speech		
			X		Difficulty waiting turn to speak		
			X		Aimless movements		
			X		Inhibition of words that don't fit context	Executive functions	
			X		Ignores irrelevant stimuli		
	X				Inhibition of repetitive responses		
X					Disorder of word and sentence structure		

Exists	Does Not Exist	Exists Little	Exists A Lot	Exists Sometimes	Indicators	Dimensions	Aspects
	X				Shifting from one instruction to another		
	X				Spontaneity during dialogue with 2+ people		
X					Ability to repeat syllables	Working memory	
			X		Ability to repeat words		
			X		Ability to repeat meaningless words		
			X		Ability to repeat		
					sentences		
	X				Emotional stability	Psychological aspect	
X					Apathy, loss of vitality & interest		
	X				Motivation		
	X				Cooperation with examiner		
	X				Feeling fatigue & exhaustion		
			X		Aggressiveness & anger		
	X				Concern with physical appearance		
			X		Frustration that others don't understand		
			X		Crying		
			X		Acceptance of illness		
			X		Pale face		
	X				Physical weakness, weight loss		

Analysis

- Severe word-finding difficulties: patient replaces missing words with religious expressions (*Ya Rabbi*) or gestures.
- Frequent neologisms and phonemic errors.
- Limited, poorly comprehensible speech, repetitive stereotyped phrases.
- However, shows **motivation to communicate** through gestures, greetings, religious expressions, and spontaneous interaction.
- Good comprehension of simple words/sentences, but struggles with complex ones.
- Cognitive issues: attention deficits, working memory weakness, executive dysfunction (poor planning, inhibition).
- Psychological aspects: apathy, fatigue, sadness, weight loss, partial acceptance of illness.
- Shows **therapeutic motivation and cooperation**, essential for speech recovery.

B/ Case 1 (Hemorrhagic Stroke) – Interview Results

Table 3. Results of Interview with Speech Therapist – Case 1

Question	**Answer**
Who diagnosed Broca's aphasia?	Myself
Do you rely on MRI or symptoms?	Yes, I rely on it for lesion localization
Initial symptoms?	Mutism
Current symptoms?	Word-finding difficulty, neologisms, normal repetition
Was there early speech therapy in hospital?	No, only neurologist's referral
Duration of therapy?	7 months
Number of weekly sessions?	Two
Duration of session?	30–45 minutes
Attendance regular?	Sometimes absent after weekends
Tools used?	MTA test
Effective?	Yes
Main factors during therapy?	Psychological and health status
Family cooperation?	Yes, especially her daughter
Linguistic improvement?	Difficult
Most affected dimension?	Expression (comprehension normal)
Memory status?	Intact
Target language in therapy?	Algerian Arabic

Question	Answer
Language best recovered?	Algerian Arabic
Alternative if no oral recovery?	Writing, if educational level allows
Therapy sequence?	Start oral, then written
Why neologisms?	Failure in word retrieval
Self-correction?	Yes, sometimes
Neologisms decrease?	With improved retrieval
Psychological state at first meeting?	Very poor, depressive, in denial
Main factor affecting recovery?	Psychological
Is 7 months enough for improvement?	Yes, some recovery
Prognosis better in hemorrhagic vs ischemic?	No significant difference
Main evaluation tool?	MTA
Family communication improved?	Somewhat
Two sessions/week enough?	Not sufficient
Which aphasia type responds better?	No difference observed

Table No. (3): Results of the interview with the speech therapist in charge of the first case. This table presents the information obtained from the interview with the speech therapist, from the moment of the stroke to the present time, and the treatment she received during this entire period.

- Analysis of the interview results:

After conducting a direct interview with the speech therapist, we found that the case was diagnosed with Broca's aphasia resulting from a hemorrhagic stroke (AVC hémorragique). At the time of her first session, she was completely unable to speak (mutism), and her psychological state was very disturbed. However, after seven months of treatment, at a rate of two sessions per week (sometimes one session due to her absence), each lasting 30 to 45 minutes depending on her health and psychological condition, she began to respond and speak, and could communicate with her family to some extent, despite frequent word-finding difficulties and neologisms. She also tries to correct her own mistakes (self-correction), although this was not observed during the administration of the MTA test. Paraphasia was absent, and repetition was somewhat normal. Psychologically, her condition improved and began to stabilize, but her desire to return home (since she was hospitalized as an inpatient) made her feel anxious and sad, which could negatively affect her language recovery.

According to the speech therapist, her memory and comprehension are intact, but she suffers only from expressive impairment. She relied on the MTA test to support recovery, starting with

oral language, using the local dialect since it is most common in daily life. However, this may negatively affect her recovery, as it would have been better to include written language in the treatment plan. The interview also revealed that her family, especially her daughter, participated in achieving the therapy goals by repeating language exercises at home, which could positively affect recovery. The speech therapist emphasized that the most influential factor in recovery (for this case and all others she manages) is the psychological factor, while the type of stroke has no impact, based on her field experience with aphasia cases at Ras El Ma hospital.

Contrary to the therapist's view, we found during our own observation that the patient's comprehension of complex sentences was clearly impaired, meaning she does not suffer from an expressive disorder only. Her working memory was also impaired, as she was unable to repeat most syllables, words, non-words, and sentences. Furthermore, phonemic paraphasia was sometimes present, despite the therapist's claim that it was absent.

- Presentation and analysis of MTA test results:

Presentation of test results:

Test	**Total Points**	**Success Rate**
Guided dialogue	8/19	42.10%
Spontaneous verbal production	2/6	33.33%
Grammatical remnants	0/1	0%
Syllable repetition	9/80	11.34%
Word repetition	2/10	20%
Non-word repetition	0/7	0%
Sentence repetition	0/2	0%
Oral naming of words and verbs	1/25	4.16%
Oral narration	0/7	0%
Oral comprehension – Words	5/5	100%
– Simple sentences	3/4	75%
– Complex sentences	1/3	33.33%
Written language – Reading aloud: Words	1/9	11.11%
– Sentences	0/4	0%
– Reading & understanding a text	2/6	33.33%

Test	Total Points	Success Rate
Written comprehension – Words	4/5	80%
– Simple sentences	1/3	33.33%
– Complex sentences	1/5	20%
Praxis tests – Buccofacial praxis	6/6	100%
– Ideomotor praxis	4/8	50%
Agnosia tests – Recognition of body parts	5/8	62.5%
– Auditory recognition	2/5	40%
– Recognition of colors	6/10	60%
– Recognition of written letters	2/3	66.66%
– Recognition of written words	2/3	66.66%

Table No. (4) represents the test results of the first case (AVC hémorragique).

- **Analysis of test results:**

From the performance of case (L.T, AVC hémorragique) in the MTA test, we observe that the results of oral language tests were very weak overall (18.45%). The weakness is due to low success rates in oral production tasks (14.10%), with a score of 0% in grammatical remnants, non-word repetition, sentence repetition, and oral narration. Many neologisms (e.g., /luzoru/, /riza/, /fi:za/, /ɣunqa/ …) were observed in her answers to these tasks.

In guided dialogue, her success rate was 42.10%. Most correct answers were yes/no questions (e.g., "Are you married?"). For open-ended questions (e.g., telling her illness story, talking about hobbies, or last trip), she failed to produce proper responses. The few words she uttered were either unintelligible (/nnwabiza:r/, /fi qiza:r/ …) or grammatically incorrect (agrammatism), as seen in her narration: *"I went out to the field then I found some kids then I fell"* where connecting elements were missing, and some events seemed omitted. For other questions, her responses were correct but short (one or two words only), such as to: *"Do you think women's participation in the labor market affects unemployment?"* (/l3aks/) or *"What do you think of women who work and leave their children at nursery?"* (/mliħa šwija/). This reflects reduced speech output and fluency.

Phonemic paraphasia appeared in her answer to *"What do you usually eat in the morning?"* where she said (ħri:b), substituting /r/ for /l/. In automatic speech production, her success rate was 33.33%. Although low, she produced many clear words (/mazidš ɣaɣa xti wallah ma jas3a/), counted numbers correctly up to six, then jumped to ten and eleven (/waħad zog ʕlaʕla

ɣaɣa rbʕa tamsa sta ʕašra ħtaš/). The correct pronunciation of numbers can be considered a strength.

B / Presentation and analysis of results of the second case (AVC ischémique): In this section, we will present the results obtained from the observation grid, interview questionnaire, and MTA test for the second case, which suffers from an ischemic stroke.

- **Presentation and analysis of observation results:**

Presentation of observation results:

Table (5): Observation Grid Results for Case Two (Ischemic Stroke)

Exists	Does not exist	Exists rarely	Exists frequently	Exists sometimes	Indicators	Dimensions	Aspects
X					Mutism	Difficulty accessing the mental lexicon	Verbal-expressive aspect
				X	Word finding difficulty		
				X	Phonemic paraphasia		
				X	Semantic paraphasia		
	X				Neologisms (invented words)		
X					Long latency to reach target word		
	X				Complete failure to reach target word		
				X	Use of religious expressions when unable to reach target word		
	X				Irregular speech flow		
	X				Phonetic disintegration		

Exists	Does not exist X	Exists rarely	Exists frequently	Exists sometimes	Indicators Reduction of syllable and word length	Dimensions	Aspects
X					Fixed verbal expression	Stereotypy	
	X				Repetition of a previous response to a later instruction	Perseveration	
		X			Repetition of greetings and thanks easily	Automatic-voluntary dissociation	
				X	Repetition of religious expressions easily		
				X	Uttering correct words during spontaneous speech		
X					Quantitative and qualitative reduction in speech	Discourse reduction	
	X				Pauses / moments of silence		
	X				Very little and unintelligible speech		
		X			Desire not to continue speaking		
	X				Expressing a whole sentence with one word	Agrammatism	
					Not observed (did not reach sentence production level)	Mixing verb tenses	

Exists	Does not exist	Exists rarely	Exists frequently	Exists sometimes	Indicators	Dimensions	Aspects
					Replacing verbs with nouns		
					Omission of connectors and pronouns		
					Great effort to link sentence units		
	X				Incoherent sentences		
	X				Monotonous speech	Prosody disorders	
				X	"Robot-like" speech		
X					Desire to communicate and convey idea	Desire & participation in dialogue	
	X				Answers only when asked		
	X				Eye contact		
		X			Picture naming	Word comprehension	Oral comprehension
		X			Comprehension of simple sentences	Sentence comprehension	
		X			Comprehension of complex sentences		
	X				Requests examiner to repeat instruction		
X					Slow, effortful, non-spontaneous movements during speech	Gestures & facial expressions	Non-verbal aspect
	X				Facial gestures & expressions		

Exists	Does not exist	Exists rarely	Exists frequently	Exists sometimes	Indicators	Dimensions	Aspects
X					Use of pointing		
		X			Susceptibility to distraction	Attention	Cognitive aspect
		X			Ability to sustain attention		
				X	Appears absent and inattentive		
		X			Executes instruction before examiner finishes		
				X	Impulsive answering		
				X	Interrupts examiner's speech		
				X	Difficulty waiting turn in conversation		
				X	Produces irrelevant movements		
				X	Inhibition of inappropriate word	Executive functions	
	X				Ignoring irrelevant stimuli		
	X				Inhibition of recurrent response		
	X				Disturbance in word and sentence structure		
	X				Switching from one instruction to another		

Exists	Does not exist	Exists rarely	Exists frequently	Exists sometimes	Indicators	Dimensions	Aspects
				X	Automatic/spontaneous language in speech		
		X			Ability to repeat syllables	Working memory	
				X	Ability to repeat words		
				X	Ability to repeat non-words		
	X				Emotional stability	Psychological aspect	
X					Indifference, loss of vitality/interest		
	X				Motivation		
	X				Cooperation with examiner		
	X				Fatigue & exhaustion		
X					Aggressiveness & anger		
		X			Concern with appearance		
		X			Frustration due to being misunderstood		
				X	Crying		
				X	Acceptance of illness		
		X			Pale face		
X					Body weakness & weight loss		

Table (5) represents the results of the observation grid for the second case (ischemic stroke). From this table, which reflects results across the following aspects: **verbal, oral comprehension, non-verbal, cognitive, and psychological**, we notice that the **verbal**

expressive aspect is the most disturbed, while comprehension is moderate. In addition, some signs point to disorders in the **cognitive** and **psychological aspects**.

Analysis of Observation Results:

Based on the results from the observation grid, we find that the **expressive aspect is the most disrupted**. This was evident in severe word-finding difficulties. The patient used a very limited set of words: /ɾi:h/ ; /ɾu:b/ ; /labas/. This prevented paraphasias (both phonemic and semantic) from appearing clearly in her speech, although they are typical symptoms of Broca's aphasia. She also required long time to answer, often failing to reach the target word, which indicates difficulty accessing the mental lexicon. At times, she invented words (neologisms), making comprehension harder. For example, when asked about her workplace, she said /ɾu:b/ and, when not understood, pointed to its location (the municipality).

She also answered with a single repeated word. In the MTA test, when asked "Are you married?", she answered /ɾi:h/, and repeated the same response to "Describe your apartment" and "Tell me how you got sick", sometimes replacing with /aha/. Silence was common when she didn't understand, though sometimes she asked for repetition. She occasionally engaged in conversation using gestures.

In comprehension, she managed to identify words and understand simple sentences, though complex ones required repetition. However, she did understand all sentences involving the word "cat", pointing at it correctly.

Cognitively, her attention was fairly good, helping her in naming tasks, though occasionally distracted. Working memory was weak (e.g., difficulties repeating words and syllables). She did not forget her medication, however.

Psychologically, the case was deteriorated. Despite therapeutic efforts to increase motivation, she was not accepting of her condition, showing distress in facial expressions during her husband's accounts. She had lost significant weight compared to before, a sign of refusal to accept her illness, which negatively affected her rehabilitation and commitment to therapy. She also showed frustration, anxiety, and anger when unable to respond, even throwing papers twice when failing to name an object (a cup).

Presentation and Analysis of the Interview Results (with the Speech Therapist and with the Patient's Husband):

Presentation of the Interview Results:

Answers	Questions	Interview with the Speech Therapist
She was diagnosed at Ras El Ma Hospital.	Who diagnosed the case as suffering from Broca's aphasia?	
I started working with her 5 months ago, but she had already undergone care in the specialized rehabilitation hospital of Ras El Ma for 3 months, as well as in a private speech therapy clinic for 2 months.	What is the duration of the speech therapy care that the case underwent?	
23 sessions.	What is the total number of therapeutic sessions?	
One hour.	What is the duration of each therapeutic session?	
No, she is not committed.	Is the patient committed to the therapeutic sessions?	
Paralysis of the right side of the face, difficulty chewing and swallowing, selective mutism (she only says the words: *Labas* and *hmm*), lack of motivation and will.	What symptoms did the patient suffer from in the first session?	
I started with the psychological aspect first, breathing, relaxation and swallowing exercises, breathing with sound production (aaaa, oooo, eeee), facial–oral massage, body image, naming family members, naming familiar objects, counting from 1 to 10.	What is the therapeutic plan followed with this case?	
Yes.	Did this therapeutic plan achieve the intended therapeutic goals?	

Answers	Questions	Interview with the Speech Therapist
Familiar pictures, lemon oil for massage, striped mirror.	What are the tools used in rehabilitation?	
The patient's psychological state.	What do you take into account when conducting therapeutic exercises?	
To some extent.	Since the family plays a role in caring for an aphasic patient, is the patient's family cooperative with you in order to achieve the therapeutic goals?	
Yes, if there are enough therapeutic sessions and the patient commits to them.	Is 5 months of care enough to notice a certain percentage of language recovery?	
Yes.	Does interruption of therapy for a certain period cause her regression?	
The expressive aspect.	Which is more disturbed in the case, verbal expression or verbal comprehension?	
It allows her to communicate to some extent.	Do the therapeutic goals achieved allow the patient to communicate effectively with her family and community?	
Yes.	Does the patient suffer from a cognitive disorder?	
She has weak memory storage.	What is the impaired cognitive function?	
Yes, I ask her to remember a sequence of letters and numbers as well as her children's pictures.	Did you conduct special memory exercises?	
Very deteriorated, as her motivation was nonexistent, she did not accept her illness, she suffered from weight loss and loss of appetite, suggesting depression.	How was the patient's psychological state in the first session?	

Answers	Questions	Interview with the Speech Therapist
I rehabilitated the psychological side before starting language rehabilitation, through raising her morale, enhancing her self-esteem, her confidence, and reminding her of the blessings and positive aspects in her life.	Does the patient undergo psychological therapy sessions?	
The psychological factor and age.	What are the factors you think affect the patient's language recovery?	
Sorry, I do not have sufficient experience to answer this question.	Based on your field experience in rehabilitating Broca's aphasia cases, have you noticed a difference in the severity of language symptoms and degree of response to the therapeutic protocol between Broca's aphasia resulting from hemorrhagic stroke and Broca's aphasia resulting from ischemic stroke?	

Interview with the Patient's Husband:

Answers	Questions
49 years old.	How old is the patient?
02/09/2020.	When did the patient have the stroke?
Ischemic stroke. The doctors told me her condition was severe.	What type of stroke did the patient have?
No.	Was the medical intervention immediately after the stroke?
Unknown.	Cause of the stroke?
Third year secondary (Management and Economics).	What is the educational level of the patient?
Member of the municipal council, associative activity.	What was the patient's profession before the stroke?
Algerian dialect.	What language was used the most before the stroke?

Answers	Questions
Arabic at a good level, French at an intermediate level.	What languages did the patient know before the stroke?
Labas.	What words does the patient pronounce correctly?
She did not accept the sudden illness and lost weight due to loss of appetite.	How was the patient's psychological state at the beginning of the illness?
She improved a lot and began to regain her self-esteem, but she still regrets her past life and profession.	How is her psychological state now?
3 months in Ras El Ma Rehabilitation Hospital immediately after the stroke, 2 months in a private speech therapy clinic in Ain Oulmane, and now 5 months in Khawla Aichouch Rehabilitation Clinic in M'sila.	What is the duration of care the patient underwent?
No, she was not cared for properly, whether physically or linguistically.	Did you notice any results from the rehabilitation in Ras El Ma?
Yes, she began to recover, and the first things she recovered were the names of her children (Arij / Mohamed).	Did you notice linguistic improvement after rehabilitation at Khawla Aichouch's clinic?
Yes.	Does the patient understand what you say to her?
We understand her after several attempts and after she uses gestures.	Do you understand what the patient says?
I don't think so, she is already close to retirement age.	Can the patient return to work again?

Table No. (6): Represents the results of the interview with the speech therapist and the husband of the second case.

This table presents the information obtained from the interview with the speech therapist and the husband of the second case, from the time of the stroke until the present, and the care she received during this period.

Analysis of the Interview Results:

Through the interview with the husband of the patient and the speech therapist in charge of her, we found that she suffered from an ischemic stroke, which occurred suddenly without a clear cause. It was not noticed at the moment of occurrence, which led to a delay in medical intervention. She was admitted immediately after the stroke to the Rehabilitation and

Functional Adaptation Hospital in Ras El Ma – Sétif – for care, where she spent 3 months. She was diagnosed by the speech therapist there as having Broca's aphasia. Despite this, she was not cared for properly, either physically or linguistically. She was then admitted to a private speech therapy clinic in Ain Oulmane for 2 months, and afterwards continued treatment in a private motor rehabilitation clinic with Khawla Aichouch in M'sila, where she received both motor and speech therapy. She attended 23 linguistic rehabilitation sessions, each lasting one hour. However, the therapist confirmed that the patient was not committed to the therapy sessions due to her deteriorated psychological state, as she has not accepted her illness to this day. This was reflected in her weight, as she lost a lot due to loss of appetite. The therapist had to act as both psychologist and speech therapist, focusing first on psychological rehabilitation by raising her morale, self-esteem, and confidence, although she remains regretful about her past life, which was also evident during the interview with her husband (in her presence). Afterwards, the therapist worked on the linguistic aspect, starting with breathing exercises with sound production, swallowing exercises, oral–facial massage using lemon oil and the striped mirror, body parts recognition, naming family members and familiar objects, as well as counting from 1 to 10. The therapist focused on the dialectal Arabic as the patient's most used language. However, the family did not provide sufficient help at home in practicing the exercises, as each member was busy with their own needs. Nevertheless, the intended therapeutic goals were achieved, especially psychological improvement, as confirmed by her husband. She also came out of the mutism she was in at the beginning, though she still suffers from word retrieval difficulty.

Presentation and Analysis of the MTA Test Results:

Presentation of the Test Results:

Test	Total Score	Success Rate
Directed Dialogue	8/19	42.10%
Spontaneous Speech Production	2/6	33.33%
Grammatical Residues	0/1	0%
Repetition of Syllables	9/80	11.25%
Repetition of Words	0/10	0%
Repetition of Non-words	0/7	0%
Repetition of Sentences	0/2	0%
Oral Naming of Words and Verbs	0/25	0%
Oral Narrative	0/7	0%
Oral Comprehension – Words	2/5	40%
Oral Comprehension – Simple Sentences	3/4	75%

Test	Total Score	Success Rate
Oral Comprehension – Complex Sentences	1/3	33.33%
Written Language – Reading Aloud (Words)	0/9	0%
Written Language – Reading Aloud (Sentences)	0/4	0%
Reading and Comprehension of Text	2/6	33.33%
Written Comprehension – Words	3/5	80%
Written Comprehension – Simple Sentences	2/3	66.66%
Written Comprehension – Complex Sentences	1/5	20%
Praxis Tests – Oral–Facial Praxis	5/6	83.33%
Praxis Tests – Ideo-Motor Praxis	3/8	37.5%
Gnosia Tests – Body Parts Recognition	4/8	50%
Gnosia Tests – Auditory Recognition	1/5	20%
Gnosia Tests – Color Recognition	3/10	30%
Gnosia Tests – Recognition of Written Letters	2/3	66.66%
Gnosia Tests – Recognition of Written Words	2/3	66.66%

Table (7): Represents the test results of the second case (ischemic stroke).

Analysis of the Test Results:

Based on the MTA test applied to the patient suffering from ischemic stroke (M.H.), we note that she obtained 14.88% in oral language, of which 8.21% was in oral production. In the directed dialogue section, she achieved 42.10%, where most of her answers were */ri:h/*, which allowed her to obtain the score since the instructions were closed questions requiring yes/no answers such as: Are you (M)? Are you married? Do you live in Maqra? She repeated her first name when asked her family name by saying */masʕu:da/*. For open questions, some she did not answer, and others she replaced speech with gestures, such as: How old are you? She showed her age with her fingers. Since when have you been ill? Describe your apartment. What do you eat for breakfast? For other questions, she only used */aha/*.

And regarding the spontaneous production item, she obtained 33.33%. In her answers, she used the words // ri:h , /a : a:/, and in her answer she was satisfied with producing the sound /u:/ for her family name and /a:/ for her first name, even though she had mentioned it previously. As for calculation, she produced the sound /a : a:/ and pointed with her hand as if she were counting correctly. However, she was able to perform the melody of a segment of the national anthem and was enjoying it while doing so. As for grammatical remnants, the success rate was 0% since the case used the word /ru:b/ in her expression for all animals. She pointed to a cat next to her, but she gave it the same word /ru:b/. She also achieved 11.34% in syllable repetition,

where she was able to repeat simple syllables //ba ra// /ma/ more than the complex ones. As for the other syllables, she made phonemic substitutions such as /du/ == /hu:/, /if/ == /a:/, while others she did not repeat at all.

She also obtained 0% in all of the following items: word repetition, nonwords, and sentences. She substituted all meaningful words such as /pa:rk/ == /ri/, /ta:qa/ == /ti:/, and nonwords such as /karam/ == /ri:h/, /boedo/ == /m/. Sometimes, she repeated the last syllable of the word such as /icher/ == /rr/, /chimo/ == /mu:/. As for sentence repetition, she invented words making up the first sentence, while for the second she only used the word /ri:h/.

She obtained 0% in the oral naming of nouns and verbs, as she was still using the same words /ri:h/, /ru:b/, /hu:b/, for example thermometer = /ri:h/, banana = /hu:b/, cradle = /ru:b/. For some others, she pointed to objects such as furniture in front of her (sofa, table). Regarding oral narration, the case did not mention the people present in the place nor the incident (the bank robbery). Her answer consisted of meaningless words /ru:f/, /ru:b/, which led to her obtaining 0% in the item.

As for oral comprehension, the percentage was 50%. She obtained 40% in word comprehension, managing to answer two instructions ("Show me the palm tree"), which she linked to the environment she lives in, and ("Show me the moon"), which she linked to Eid and Ramadan. She did not answer at all to the instruction ("Show me the house"), and for the last two instructions, the answers were wrong. She obtained 75% in simple sentences; she did not answer the first instruction ("Show me a man eating"), as she pointed several times, which led to canceling the answer. But for the remaining instructions, the answers were correct. She then obtained 33.33% in complex sentences, answering only one instruction ("Show me a man wearing a *chachia* and kissing his daughter").

As for written language, the percentage was 24.24%, distributed as follows: 10% in production. She obtained 0% in reading aloud, but she pointed to the cat when reading the sentence "The white mill cat broke the lamp." For the other sentences, she only used the words /ri:h/; /ru:b/. She obtained 33.33% in reading and understanding the text; she could not read the text aloud, and when answering comprehension questions, she just pointed to the word or sentence that answered the question. For example: "What was stolen?" → she pointed to the car. "Did the police find the child?" → she pointed to the answer in the text. For the other questions, either the answer was late (beyond the time allowed), which led to its cancellation, such as "Did they take a long time to find the child?" or the answer was completely wrong.

As for written comprehension, she obtained 46.15%. She obtained 60% in word comprehension. The case showed some anxiety and frustration at not being able to point to the

cup and binoculars, always missing the target word, so the test was stopped due to the deterioration of her psychological state. For simple sentences, she obtained 66.66%, as she failed to identify "the dog jumps" only. For the complex sentence, she obtained 20%, answering only one instruction: "The woman scolded her cat because it knocked over the cup." We noticed that she was able to answer all items containing the cat, as she takes care of a cat at home. She could not answer the rest.

Regarding apraxia and agnosia items, she obtained 52.63%. Apraxia was 57.14%, distributed as follows: in oral-facial apraxia, she obtained 83.33%, where she was able to carry out all the instructions except one, which was whistling. In ideomotor apraxia, she obtained 37.57%, where she managed all simple commands but not the complex ones. For example, in the instruction "Take the key and put it in the lock," she took a long time as she inserted the key upside down without realizing it.

As for agnosia items, the percentage was 50%, distributed as follows: 62.5% in recognizing body parts, where, when unable to recognize, she looked toward her daughter. In auditory recognition, 20%, as she recognized only one sound, the national anthem, and even sang along with it. For colors, 30%; she failed to match the target picture with the displayed one except in rare cases, as she did not pay attention to all the colors, only to the first one, which made her answer wrong each time. She obtained 66.66% in both recognizing written letters and recognizing words, as she managed to identify the target letter in the two boards presented but failed in one, and similarly for words: she identified the target word in two boards but not in the third.

2/ Presentation and Discussion of the Hypothesis Results:

In this section, the results of the general hypothesis and the two sub-hypotheses will be presented and discussed in light of the theoretical framework and previous studies.

A/ Presentation of the Hypothesis Results:

General hypothesis results:

Success rate	Case	Test
18.45%	AVC hémorragique (L.T)	Oral language
14.88%	AVC ischémique (M.H)	Oral language

Table (8): Represents the results of both cases in oral language.

From Table (56), we observe that the first case (AVC hémorragique) obtained 18.45% in oral language compared to the second case (AVC ischémique), which obtained 14.88%. Thus, the results of the first case are better than the second.

First sub-hypothesis results:

Test	Case	Success rate
Oral production	AVC hémorragique (L.T)	14.10%
	AVC ischémique (M.H)	8.21%

Table (9): Represents the results of both cases in oral production.

Table (9) shows that the AVC hémorragique case obtained 14.10% in oral production, which is better compared to the AVC ischémique case, which obtained 8.21%.

Second sub-hypothesis results:

Test	Case	Success rate
Oral comprehension	AVC hémorragique (L.T)	75%
	AVC ischémique (M.H)	50%

Table (10): Represents the results of both cases in oral comprehension.

From Table (10), we observe that the AVC hémorragique case obtained 75% in oral comprehension, which is better compared to the AVC ischémique case, which obtained 50%.

B/ Discussion of the Hypotheses' Results

Discussion of the General Hypothesis:

The general hypothesis states that there is a difference in the retrieval of oral language in both Broca's aphasia resulting from a hemorrhagic stroke and Broca's aphasia resulting from an ischemic stroke. This is indeed what we found. The case suffering from a hemorrhagic stroke obtained a success rate of **18.45%** in the oral language items of the MTA test, while the case suffering from an ischemic stroke obtained a success rate of **14.44%**. Thus, we observe that the first case (AVC hémorragique) achieved better retrieval than the second case (AVC ischémique). This was confirmed by the study of **Stefano et al. (2022)**, which concluded that functional recovery in hemorrhagic stroke cases was two and a half times better than in ischemic stroke cases after comprehensive functional rehabilitation that also included language rehabilitation. This is due to the fact that patients with hemorrhagic stroke experience rapid neurological improvement as the hematoma (hématome) is absorbed. Functional improvement is therefore essentially linked to neurological improvement.

Renhual Liu et al. (2021) noted that in hemorrhagic stroke, neuronal damage occurs mainly due to edema (œdème) and hematoma, which develop rapidly in the first few hours, leading to increased intracranial pressure and neuronal death as a result of this pressure. However, later, microglial cells activated in the affected area (hematoma region) as early as one hour after hemorrhagic stroke work to absorb the hematoma and promote axonal regeneration. Thus, the

intervention of microglia, which are abundant in the central nervous system, can reduce hemorrhage-related brain damage and open the way for functional and linguistic recovery.

The agreement between our results and those of **Stefano et al. (2003)** may be due to the fact that both studies were matched and controlled regarding factors that may affect recovery (age, gender, severity of injury, etc.), which was also a focus in our study.

Similarly, the study by **Audrey et al. (1989)**, titled *Predictors of Language Restitution Following Stroke*, confirmed that stroke type (in favor of hemorrhagic stroke) is among the factors associated with recovery, though age (in favor of younger patients) is the most influential factor. Another study, **Young Jung et al. (2011)**, found that stroke cases responded well to speech therapy combined with transcranial magnetic stimulation.

The oral language recovery of the first case (AVC hémorragique) was better than that of the second case (AVC ischémique). This is not necessarily due to the stroke type, as we inferred other factors from the interviews conducted with both speech therapists and the husband of the second case. The family of the first case (AVC hémorragique) was actively involved in her language recovery and helped her repeat exercises at home. The speech therapist also used the MTA test in evaluation and rehabilitation. In contrast, in the second case (AVC ischémique), the speech therapist did not use the MTA test, and the family did not provide support. Despite this, the recovery of the first case (AVC hémorragique) remained weak, which could be attributed to the short rehabilitation period (7 months) and its late initiation (7 months post-stroke). These two factors (timing of rehabilitation onset and its duration) are considered among the most important for recovery.

Demeurisse et al. (1980) confirmed that the best recovery occurs in the first three months after stroke, declining and slowing thereafter. On the other hand, full linguistic recovery is not possible even with early and intensive therapy. **Ann Stark (2010)** studied a single case (47 years old, initially global aphasia evolving into Broca's aphasia following a left-hemisphere hemorrhagic stroke). She designed a language therapy protocol tailored to Broca's symptoms (anomia, speech and sentence production difficulties, reduced fluency) for 7 years. Despite this, the recovery rate was only 80%.

Conversely, the study of **Chan-Lin Chu et al. (2022)** found no difference in language recovery between hemorrhagic and ischemic stroke cases using the Chinese Concise Aphasia Test (CCAT) after a comprehensive rehabilitation program (linguistic, occupational, motor, etc.). The difference between their results and ours may be explained by sample size (42 hemorrhagic stroke cases, 200 ischemic stroke cases), lack of control over influencing factors, or differences

in rehabilitation comprehensiveness, intensity, and continuity—unlike the discontinuous rehabilitation of our second case (AVC ischémique), which negatively affected recovery.

Overall, both cases showed weak oral language recovery, as Broca's aphasia symptoms remained prominent. This may be because neither underwent early and intensive speech therapy. Even though the second case (AVC ischémique) received 3 months of therapy (one session per week) post-stroke, it coincided with the COVID-19 period, reducing its intensity. Her husband reported no visible results.

Saur et al. (2012) showed that recovery in stroke cases progresses through three phases:

- Acute phase (less than 4 days post-stroke)
- Post-acute phase (less than 4 months post-stroke)
- Chronic phase (between 4 and 12 months post-stroke)

In the chronic phase, language symptoms stabilize and rehabilitation outcomes weaken. **Chan-Lin Chu et al. (2020)** also emphasized the special importance of the post-acute phase for rehabilitating stroke-related impairments (linguistic, cognitive, motor).

We also noted that oral production (8.21%–14.10%) and written production (10%–15%) in both cases were weak and close. This was due to the therapists not including written-language exercises (such as reading aloud) and focusing only on oral naming, phoneme cueing, and oral word repetition. This was confirmed in both the interviews and our observation of their therapy sessions. They justified this by considering oral language as the most used and thus the basis of rehabilitation for communicative quality of life, even though both patients' educational levels allowed for written-language exercises, which could have reinforced oral recovery.

Leora (2010) found improved naming when nonfluent aphasia patients engaged in language therapy based on reading sentences of increasing length aloud. Similarly, **Basso et al. (1982)** found that recovery of oral expression, written expression, and comprehension were interconnected in patients undergoing language rehabilitation, meaning that recovery in one skill influences the others.

Discussion of Partial Hypothesis 1:

Partial Hypothesis 1 states that oral production recovery in Broca's aphasia due to hemorrhagic stroke is better than in Broca's aphasia due to ischemic stroke. Our study confirmed this: the first case (AVC hémorragique) scored **14.10%**, while the second case (AVC ischémique) scored **8.21%**.

This contradicts **Noh et al. (2020)**, which found that hemorrhagic stroke cases (33 cases) scored lower than ischemic stroke cases (8 cases) in naming and repetition items of the Western Aphasia Battery (WAB). The discrepancy may be due to their study measuring spontaneous

naming and repetition recovery one month post-stroke, when hemorrhagic cases typically show more severe symptoms than ischemic ones. **Lahiri et al. (2020)** also confirmed that hemorrhagic stroke leads to more severe linguistic symptoms, based on an evaluation of 515 stroke patients (hemorrhagic/ischemic) using the Bengali WAB between day 3 and day 7 post-stroke.

Wilson and Fridriksson explained that in the acute phase (immediately post-stroke), hemorrhagic stroke consequences are more severe than ischemic stroke, as seen in higher mortality and longer hospital stays. However, if the patient survives the acute phase, recovery can surpass that of ischemic stroke patients. Thus, timing of language assessment (as in Noh et al. 2020 vs. our study) explains the discrepancy. Another reason may be sample heterogeneity (lesion site, age, gender, education level, etc.).

We also note that both cases scored poorly in oral production, although their results in oral-facial apraxia were very good (83%–100%). This is due to the therapists initially focusing on oral-facial massage to facilitate fine motor movements for speech and swallowing. This enabled both cases to perform all oral-facial apraxia tasks except whistling, which the second case (AVC ischémique) could not perform. This contrasts with **Renzi et al. (S.A.)**, who found a strong correlation between oral-facial apraxia and oral production disorders, and identified apraxia as one of the most common comorbidities in Broca's aphasia.

Discussion of Partial Hypothesis 2:

Partial Hypothesis 2 states that there is a difference in oral comprehension recovery between Broca's aphasia due to hemorrhagic stroke and Broca's aphasia due to ischemic stroke. Our study confirmed this: the first case (AVC hémorragique) achieved **75%** in comprehension items, compared to the second case (AVC ischémique) at **50%**.

Both cases' comprehension scores were higher than their oral production scores. **Demeurisse et al. (1980)** similarly found that comprehension scores in Broca's aphasia were higher than expression scores after daily speech therapy sessions for six months following ischemic stroke. **Mazzouni et al. (1995)** only compared oral expression recovery and not comprehension, as comprehension was intact in both their groups at baseline. Thus, the relatively high comprehension results in our cases may be because comprehension was less impaired from the outset, consistent with Broca's aphasia being nonfluent, mainly affecting production.

On the other hand, **Young Jong et al. (2011)** found that recovery was better in fluent aphasia cases, as comprehension is more impaired and thus more recoverable compared to expression.

Conclusion:

Stroke (AVC) inevitably leads to loss of certain functions, including language. Most patients

are diagnosed with Broca's aphasia, requiring speech therapy to promote language recovery. The brain has the unique ability of reorganization and compensation (neuroplasticity), enabling patients to recover language, at least partially. However, this recovery is complex and unpredictable, as it is influenced by factors such as severity and location of the lesion, gender, age, handedness, bilingualism, educational level, health and psychological condition, timing and duration of therapy, type of aphasia (fluent/nonfluent), and stroke type (ischemic vs. hemorrhagic), due to their different pathophysiologies.

Our study aimed to examine differences in oral language recovery (comprehension/production) between Broca's aphasia following hemorrhagic stroke and Broca's aphasia following ischemic stroke. Using the MTA test and controlling for confounding factors, we confirmed the existence of differences. The hemorrhagic stroke case showed better overall oral language, oral production, and comprehension recovery than the ischemic stroke case. The difference was minimal in oral production but more notable in comprehension. Both cases nonetheless showed weak recovery overall, especially in production, as it is more impaired than comprehension in Broca's aphasia.

These results cannot be generalized, as our sample included only two cases. Furthermore, the recovery difference cannot be conclusively attributed to stroke type, since other factors such as continuity of therapy and the therapist's approach may have influenced outcomes. Additionally, we only conducted post-therapy assessment without pre-therapy measurement. We therefore recommend conducting larger, more homogeneous studies comparing groups of Broca's aphasia due to ischemic stroke versus hemorrhagic stroke, with equal therapy duration, identical therapists, and standardized exercises, to better determine recovery differences.

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