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Pattern of language recovery relating to bilingualism in Ao Naga and English language: A case presentation

Koyel Das[1]
Department of ENT, Nazareth Hospital, Meghalaya, India
Henry Benson Nongrum[2]
Department of ENT, Nazareth Hospital, Meghalaya, India
Ruchira Mukherjee[3]
IIT Kharagpur, West Bengal, India
Deepanshi Vaish[4]
Step by Step School, Panchasheel Park, New Delhi, India
Dibyendu Das[5]
OEC(AIISH), AIIMS, Bhubaneshwar, India

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Abstract

Background: Most of the population of the world is bilingual and the language emergence process in bilingual aphasics can be indifferent based on various factors. The similarity between First Language (L1) and Second Language(L2), age of second language(L2) acquisition, and usage of L2 are some of the possible factors that might contribute in the emergence of languages in Aphasic patients. The aim of the study is to introspect the early intervention of language therapy in a bilingual aphasic with Ao Naga as the L1 and English as L2.

Case Presentation & Methods: A n adult 42-year-old male was referred to a tertiary health centre with a complaint of altered sensorium. Later the patient was referred to the Otolaryngologist and SLP(Speech Language Pathologist) with the complaint of limited speech and language skills and difficulty in swallowing. When the SLP assessed the patient with WAB-R(Western Aphasia Batter-Revised) and N-DAT(Newcastle Dysarthria Assessment) and MASA(Mann Assessment of Swallowing Ability),he was diagnosed with Broca's Aphasia with Spastic Dysarthria and Oro-pharyngeal Dysphagia.

[1] Koyel Das is currently working as an SLP and Audiologist in the Department of ENT, Nazareth Hospital, Shillong, Megahlaya, India
Corresponding author: koyeldasaslp@gmail.com
ORCID ID: https://orcid.org/0000-0001-7055-1594
[2] Henry Benson Nongrum is an HOD and Otolaryngologist. His areas of research interest are otolaryngology, audio-vestibular sciences and head and neck surgery.
[3] Ruchira Mukherjee is a project scientist and her areas of interest are argonomics and bio-statistics.
[4] Deepanshi Vaish is a Speech Therapist and her area of interest is Child and Adult Language Disorders.
[5] Dibyendu Das is an audiologist and his areas of Interest are Audiology and speech sciences.

Results: WAB-R scores improved when assessed after post-therapy of 10 sessions of 45 minutes duration and showed significant ($p<0.01$) strong positive correlations and significant differences on the pre and post-therapy WAB scores. Parallel emergence of L1 and L2 was seen during and post-therapy in the patient.

Conclusion: The study concludes that in bilingualism aphasia, both the L1 and L2 can emerge at the same time. The L2 might in fact, contribute more in recovering the L1 based on usage, proficiency, and exposure.

Keywords: bilingualism, aphasia, language therapy, language

1. Introduction

Aphasia is rarely a pure neurological syndrome and often is subjected to multidimensional aspects. There are different studies which highlight the fact about bilingualism in Aphasia and its possible difficulties. The most important issue to be addressed is the effect of aphasia affecting the structure of first language(L1) and Second language (L2), and to what extent and possible early probability of emerging of the either L1 or L2, post-stroke, after extensive language therapy in bilingual aphasics. There are different literature focusing on conceptual descriptions of aphasia in two languages, that is, L1 and L2 and different possible factors involved in emerging of the same during recovery. The neuropsychological approach in understanding the bilingual language processing would be remarkable in understanding the same (Beaton et. al, 2007; Weekes et.al,2008).

According to clinical studies, multilingual aphasia results in dissociations between L1 and L2 processing, with one language processing more poorly than the other. In some situations, a distinct recovery pattern is seen, with L2 regained just subsequent to L1. Another pattern is alternating antagonism, in which patients speak spontaneously in one language while suppressing the other for brief intervals of time (Abutalebi et. al, 2007). The compensatory behaviours in bilingual aphasia are a consequence of improved language control that aligns with the concept proposed by Green (1998) (Penn et. al,2007). There are also studies that depict that semantic system is involved in both forward (L2 → L1) and backward translation (L1 → L2) (Kroll et al,1994).

Whether L1 or L2 should be utilized in treatment with bilingual speakers is a question raised by Ansaldo and colleagues. They contend that Green's approach provides an explanation for language preference and provide an example using a bilingual customer who switches between Spanish and English without conscious thought. To address involuntary language switching, Ansaldo et al. use a self-regulated technique called Switch Back through Translation, which involves cueing the target language to translate name mistakes. Their findings confirm the presence of inhibitory processes proposed by Green's model, which includes an external suppression mechanism that enables naming and an internal suppression mechanism that facilitates translation. As with gestures, mimicry, and drawing, preserved Language Switching (LS) and Language Mixing (LM)abilities should be strengthened and taken into consideration as a

compensatory strategy to offset the unavailability of linguistic information, given that mixing and switching are distinctive pragmatic features in bilingual communication. Additionally, even in pathological situations, LM and LS may be used in conjunction with translation to prevent misunderstandings and promote target word access (Ansaldo et. al, 2008).

The switching between the languages involves general executive processing with overlapping areas of the brain and increased activity of Dorsolateral Prefrontal Cortex as well (Hernandez et. al, 2001).

Damage to the right hemisphere impacts lexical retrieval, prosodic processing, semantic processing, and a variety of pragmatic skills thought to be necessary for effective communication in Bilingual Aphasics (Puente et. al, 1992).

The overall cortical area of the L1 and L2 representations was comparable, but their anatomical distributions differed markedly. While the L1 and common sites were distributed across the mapped regions, the L2-specific sites were located only in the posterior temporal and parietal regions. When compared to the distribution of language sites in monolinguals, bilinguals', seven peri-sylvian language zones showed a marked underrepresentation of L2 locations. The L1 and L2 sites had different functions (Paradis et. al,2004).

Preferring one language over the other, a bilingual patient with aphasia may have a differentiated recovery that leads to a greater functional brain recovery. Additionally, the increasing usage of one language may harm the process for language choice or selection, as well as functionally improve its network and gradually isolate it from the other language. In a similar vein, a selective improvement might be sparked by the separation of the meanings of words from their coding (Dupont,1992).

Overall, 40% of bilingual aphasics experienced parallel recovery, 32% showed better recovery of L1 than L2, whereas 28% showed more improvement in L2 than in L1(Dupont et. al,1992). A recent study included machine learning models in treating treated language improvement (TLI) and transfer to the untreated language (cross-language generalization, CLG) with an aim to identify the key predictive features (eg, patient severity, demographics, and treatment variables) aligning with clinical evidence. The study concluded that factors such as patient severity and demographics predict TLI and CLG after therapy in Spanish-English bilingual individuals with poststroke aphasia (Marte et al.,2025).

The study was done to introspect the effectiveness of early intervention of language therapy in bilingual aphasic patients speaking Ao as the first language (L1) and English as the second language (L2).

2. Case Presentation and Methodology

An adult male of 42 years referred in our hospital with the complaint of altered sensorium, from a local Primary Health Care centre where CT scan was done and when repeated which revealed Intracerebral haemorrhage in left frontal lobe, left ganglio-capsular region and left insular cortex. Minimal subarachnoid haemorrhage in left temporal region and chronic lacunar infarct was also observed.

Patient was presented to the Otolaryngologist and Speech and Language Pathologist (SLP) due to difficulty in swallowing ability and limited speech and linguistic skills.

Patient when assessed presented with complaint of limited speech and language skills with comparatively good auditory comprehension. Patient could follow simple step commands as well as simple sequential commands. The patient could point to the objects when given stimulus (common lexical items) without cues. The oro-motor difficulties seen were limited tongue protrusion and extension, poor tongue kinematics, deviation of the angle of mouth towards right side, inadequate labial closure with mild drooling. Patient was able to repeat few monosyllables with respect to that produced in Ao Naga language. Patient also had swallowing difficulty for liquids with mild aspiration.

Patient was assessed with WAB (Western Aphasia Battery) and N-DAT (Newcastle Dysarthria Assessment) and was diagnosed with Broca's Aphasia and Spastic Dysarthria. The WAB scores for Fluency was 0.6, Auditory Comprehension was 6.4, for Repetition was 0 and for Naming was 1 respectively. The patient was evaluated for motor-speech and oro-motor functions using N-DAT (Newcastle's Dysarthria Assessment) and was diagnosed with Spastic Dysarthria and the persistent clinical symptom for the same was abnormal MPD (Maximum Phonation Duration), Pitch glide. Voice was perceived as wet and gurgley with monopitch and monoloudness, poor breathing pattern. Tongue function test revealed the Level 2 with presence of fasciculation of the tongue and deviation of the tongue towards right side.

Swallowing ability was assessed using MASA (Mann Assessment of Swallowing Ability) was the obtained score was 150 which was suggestive of Moderate Dysphagia and had prolonged Oral Transit Time (OTT), inadequate hyolaryngeal movement, impaired bolus capture with spilling of bolus and poor cough reflex.

When patient was assessed with WAB (Western Aphasia Battery) in which the duration of assessment was approximately one and half hour in English. Though the L1(First Language) of the patient was Ao and the L2(Second language) was English, WAB was administered in English due to the unavailability of the test in the L1.

The four sub domains of the WAB-R are (1) spontaneous speech; (2) auditory comprehension; (3) repetition; and (4) naming. The purpose of these sub-domains is to assess the severity of language impairment, identify the kind of linguistic deficiency, and establish whether aphasia is present. The total score for spontaneous speech is 20, which takes into account both information content and fluency. The total points for auditory comprehension is 200 consisting of 60 points for Yes–No questions, 60 points for auditory word recognition, and 80 points for sequential commands. The total score for repetition is 100. A total of 100 points are given for naming, including 60 points for object naming, 20 points for fluency of words, 10 points for sentence completion, and 10 points for responsive speech. The total points are first converted into minimum score by considering 10% for repetition and naming and 20 % of score for comprehension.

The patient scored 12 for spontaneous speech,6.4 in comprehension,1 in naming and 0 in repetition task respectively. When the Aphasia Quotient (AQ) was calculated using the formulae

$$AQ = (Spontaneous + Comprehension \div 20 + Repetition \div 10 + Naming \div 10) \times 2,$$

and the score obtained was 24.84 which determined Very Severe Broca's Aphasia (Yan et. al,2022). The scores were awarded based on the participant's response to the stimulus provided during the test.

The non-verbal skills assessment that is reading and writing, praxis, construction was excluded during the testing considering the bedridden condition of the patient. The pre-therapy WAB scores are given in the Table 1.

Table1
Pre-therapy WAB scores in the four domains

	Fluency	Auditory comprehension	Repetition	Naming
Maximum Score for Broca's Aphasia	0-4	4-10	0-7.9	0-8
Patient Score	0.6	6.4	0	1

2.1. Therapeutic techniques incorporated

2.1.1. Melodic Intonation Therapy

The subject was only exposed to the first to monosyllables and combination of those monosyllables making it into a meaningful word in Ao language (eg. /ya/ and /yu/ combination resulting in /yayu/ meaning Sister) through singing after the SLP stated it once to explain the process. The participant was given singing instructions after the SLP repeatedly modelled the monosyllables thus turning into bisyllabic words. In addition to providing an extra cue during singing, the SLP helped the participant tap the rhythm of the words with his or her left hand. This is thought to help with motor planning for vocalizing the phrase (Thaut, 2005). In the sessions that followed, the SLP decided whether or not to add a new word. Only the first 3 words were covered in the second session; however, in the third session, the participant was given the opportunity to learn phrases with the different combinations of Consonant and Vowel (CV) combinations to make it into meaningful words in L1(Ao) would help along with L2(English).

The same process was carried out in L2, for example /ma/ and /ma/ combination resulting into /mama/ in L2 and L1 as well.

2.1.2. Semantic Therapy tasks included

2.1.2.1. Semantic Associated Matching

The subject was shown the target image along with two additional object photographs, one of which had semantic similarities to the intended recipient. When given a choice between a fork and a chimney, the participant

was asked to name the corresponding visual, such as "which one goes with the knife?" Binary choices were given along with the targeted stimulus. The stimulus was provided in both L1 and L2 and then cues were provided for the same using pictures and explaining the function of the targeted stimulus.

2.1.2.2. Functional Questions

The subject was shown the target image along with two closed, standard-format questions, such as "Can you verb a target?" and "Can you kick a football?" or "Can you eat a football?" The patient was encouraged to answer in either Ao Naga or English, whatever was preferable for him.

2.1.2.3. Naming to definition

A target picture and its definition were shown to the participant. Carrots, for instance, were defined in English as "a type of root vegetable." Rabbits enjoy eating them because they are orange, slender, and lengthy. It was up to the participant to identify the image. The SLP provided cues for the name if he was unable. Semantic Priming was incorporated to elicit the targeted responses in either L1 or L2

2.1.2.4. Semantic Feature Analysis

After seeing the target image, the participant was asked to characterize its semantic elements. The SLP used appropriate cue questions, including "Where would you find it?" and "What would you do with it?" In addition, the SLP offered qualities that the patient could choose to embrace or reject. A fresh target image was provided after the previous targeted stimuli has been correctly elicited or answered by the patient.

2.1.3. Phonological therapy task included

The participant was asked to repeat the spoken name after seeing the target picture.

a) Phonological queuing

The subject was asked to construct the word after seeing a target picture and hearing a phonological cue that included the word's first phoneme or cluster.

Rhyme judgement:

A rhyme question, such as "Does this word rhyme with parrot?" (for the target word "carrot") was provided with the target picture. There were an equal number of questions that required answers of "yes" or "no." For instance, a participant might be asked, "Does this word rhyme with hammer?" (for the target word "carrot") on another occasion. The minimal pair combinations were provided mostly in L2 as English has lot of contrast minimal pair as well, e.g.- combination of bat and cat and replacement of phoneme /b/ and /k/ was easy w.r.t pictures.

b) Syllable counting

The participant was shown the target picture. If they were able to give it a name, they did; if not, the SLP did. Next, the subject was asked to specify

how many syllables were in the term. If not, the therapist encouraged her or him to count the syllables by tapping out the number. The temporal aspects were also incorporated for the syllables and L1 syllables and L2 syllables were combined separately and responses were elicited whichever was preferable for the patient to comprehend and express.

c) Initial phoneme judgement

The participant was shown the target image along with the spoken name. He or she was instructed to pronounce each word's initial sound, such as "this word is potato." What is the potato's initial sound? When a patient was having trouble, the therapist would say, "The word begins with /p/. /p/ for potato". The task was carried out in L1 and L2 to make the patient more familiar of the different combinations of vowels and consonants and the place of occurrence of the same in the respective languages.

2.1.4. Verb Network Strengthening Treatment (VNeST)

Verb Network Strengthening Treatment is a semantic treatment which aims to improve the lexical retrieval of content words in sentence context by promoting semantic retrieval of verb and the respective thematic roles. For those with moderate aphasia, VNeST may be useful in helping them advance from single word naming to connected speech (Edmonds et. al, 2009). VNeST has been proved to be beneficial for bilinguals, so in this case as well, VNeST was incorporated (Li et. al, 2021).

The verbs of the probe stimuli were presented in random order for elicitation of naming and no semantically related verbs were presented consecutively. For every sentence probe image, the subjects were asked to make sentence/phrases which included him in the action with the experimenter pointing to the agent, verb, and patient (Edmonds et al., 2009) in either L1or L2.

2.1.5. Response Elaboration Training (RET)

The goal of RET is to improve the verbal productivity with respect to content and length of utterances. The changes included practicing complex utterances repeatedly, using integral stimulation, and providing more clinical modelling. The picture sets were provided to the patient and was asked to tell as much as he can about the picture either in AoNaga or English. After the patient completed the task, he was asked to say about any extra information that he would like to provide regarding the same. Personal recounts were also provided (e.g. Talking about anything that happened yesterday at least for 5 minutes). Across the measurement circumstances, treatment administration was counterbalanced (e.g., Picture Set 1 → Picture Set 2 → Personal Recount; Personal Recount → Picture Set 2 → Picture Set 1).

Post-therapeutic Language Intervention the patient scored 3 in Fluency, 10 in auditory comprehension,7.5 in repetition and 6.5 in naming tasks.

The patient had persistent difficulty in Naming but improved with cues. Paraphasic affecting metrical information of speech was observed. Phonemic paraphasia with preservative, epenthetic and substitution errors seen in L1

and relatively less in L2. Neologistic Paraphasia was also observed while answering in long sentences in both L1 and L2.

3. Findings

The patient was previously provided with speech and swallowing therapy during his hospital stay; later after discharge the language therapy was initiated. The priority was given to the speech and swallowing abilities rather than linguistic skills considering the medical intervention and feeding abilities to be intervened first. But during the hospital stay patient was provided stimulus for improving comprehension of common lexical categories that is required in ADL (Activities of Daily Living).During that patient was communicating using gestures.

Swallowing therapy included postural modifications, dietary modifications and manoeuvres and swallowing exercises and there was a good prognosis within the duration of 5 days, thus RT (Ryle's Tube) was removed and oral diet was initiated. Speech therapy included improvement of tongue kinematics and labial kinematics with respect to the movements of the same at rest and during speech. Oro-motor exercises were incorporated and thus improvement in the tongue and labial kinematics was observed.

After discharge from the hospital patient was provided language therapy for 10 sessions. There was a gap of almost 10 days when from the day when language therapy started and discharge from the hospital. Then, the language therapy was commenced when the patient was physically stable and was willing to attend the language therapy. The language therapy was scheduled to be thrice in a week for 45 minutes and was provided with Home training as well. The WAB scores were obtained during hospital stay and before the language therapy began where language domains like the fluency, auditory comprehension, naming and repetition improved. The overall interventional aspects provided to the patient along with the duration and short term therapy goals are described in the Table 2.

Table 2

Overall interventional aspects provided considering the short term goals, therapeutic techniques, treatment schedule and day-to-day scores in the four main domains of WAB of the patient

Short-term goal of therapy	**Therapeutic strategies used**	**Treatment schedule (day and duration)**	**Stimulus provided**	**Post therapy scores w.r.t days**
1.To Improve Comprehension and Expression of Common Lexical Categories 2.To Improve Propositional Speech	MIT (Melodic Intonation Therapy) -Semantic Therapy Verb Network Strengthening Treatment	DAY 1 45 MINS	- Semantic associating matching - Semantic feature analysis - Repetition of target (picture	Fluency-03 Auditory Comprehension-10 Repetition-3 Naming-2

			naming) with cues	
3.To Improve Comprehension and Expression of Common Lexical Categories 4.To Improve Propositional Speech	-MIT -Semantic Therapy Verb Network Strengthening Treatment	DAY 2 45 MINS	Semantic associating matching - Semantic feature analysis	Fluency-03 Auditory Comprehension-10 Repetition-3.75 Naming-2.75
5.To Improve Comprehension and Expression of Common Lexical Categories	Verb Network Strengthening Treatment Semantic Therapy	DAY 3 45 MINS	Semantic feature analysis - Repetition of target (picture naming) with cues	Fluency-03 Auditory Comprehension-10 Repetition-4.50 Naming-3.75
6.To Improve MLU (Up to 3 Words) Using Nouns and Pronouns	Verb Network Strengthening Treatment, -Semantic Therapy	DAY 4 45 MINS	Semantic feature analysis - Repetition of target (picture naming) with cues	Fluency-3.75 Auditory Comprehension-10 Repetition-5.2 Naming-4.0
7.To Improve MLU (Up to 3 Words)Using Verbs And Adjectives	-Verb Network Strengthening Treatment, -Response Elaboration Training	DAY 5 45 MINS	- Semantic associating matching - Semantic feature analysis - Functional questions	Fluency-03 Auditory Comprehension-10 Repetition-5.75 Naming-4.75
8.To improve MLU (up to 3 words) using minimal pairs, opposites, Naming 9.To improve lexical retrieval of content words in sentence context by promoting systematic retrieval of verbs (e.g., *measure*) and their	Verb Network Strengthening Treatment, - Semantic Therapy -Response Elaboration Training	DAY 6 45 MINS	- Phonological therapy including phonological cueing, rhyme judgement - Semantic associating matching - Semantic feature analysis	Fluency-3.75 Auditory Comprehension-10 Repetition-6.0 Naming-5.2

thematic roles—i.e., agent				
10.To Improve MLU (Upto 3 Words) -To improve lexical retrieval of content words in sentence context by promoting systematic retrieval of verbs (e.g., *measure*) and their thematic roles—i.e., agent	Verb Network Strengthening Treatment, -Semantic Therapy -Response Elaboration Training	DAY 7 45 MINS	- Functional questions -Naming to definition Semantic associating matching - Semantic feature analysis	Fluency-3.75 Auditory Comprehension-10 Repetition-6.25 Naming-5.45
11.To Improve Phonological and Grammatical Efficiency	Phonological Component Analysis (using Rhyming words, first sound, number of syllables, another related word) -Semantic Therapy	DAY 8 45 MINS	Phonological therapy including phonological cueing, rhyme judgement	Fluency-3.75 Auditory Comprehension-10 Repetition-6.50 Naming-5.75
12.To Improve Phonological and Grammatical Efficiency	Phonological Component Analysis (using Rhyming words, first sound, number of syllables, another related word) - Semantic Therapy	DAY 9 45 MINS	Phonological therapy including phonological cueing, rhyme judgement	Fluency-3.75 Auditory Comprehension-10 Repetition-6.75 Naming-6.25
13.To Improve Phonological and Grammatical Efficiency	Phonological Component Analysis (using Rhyming words, first sound, number of syllables, another related word) - Semantic Therapy	DAY 10 45 MINS	Phonological therapy including phonological cueing, rhyme judgement	Fluency-3.75 Auditory Comprehension-10 Repetition-7.5 Naming-6.5

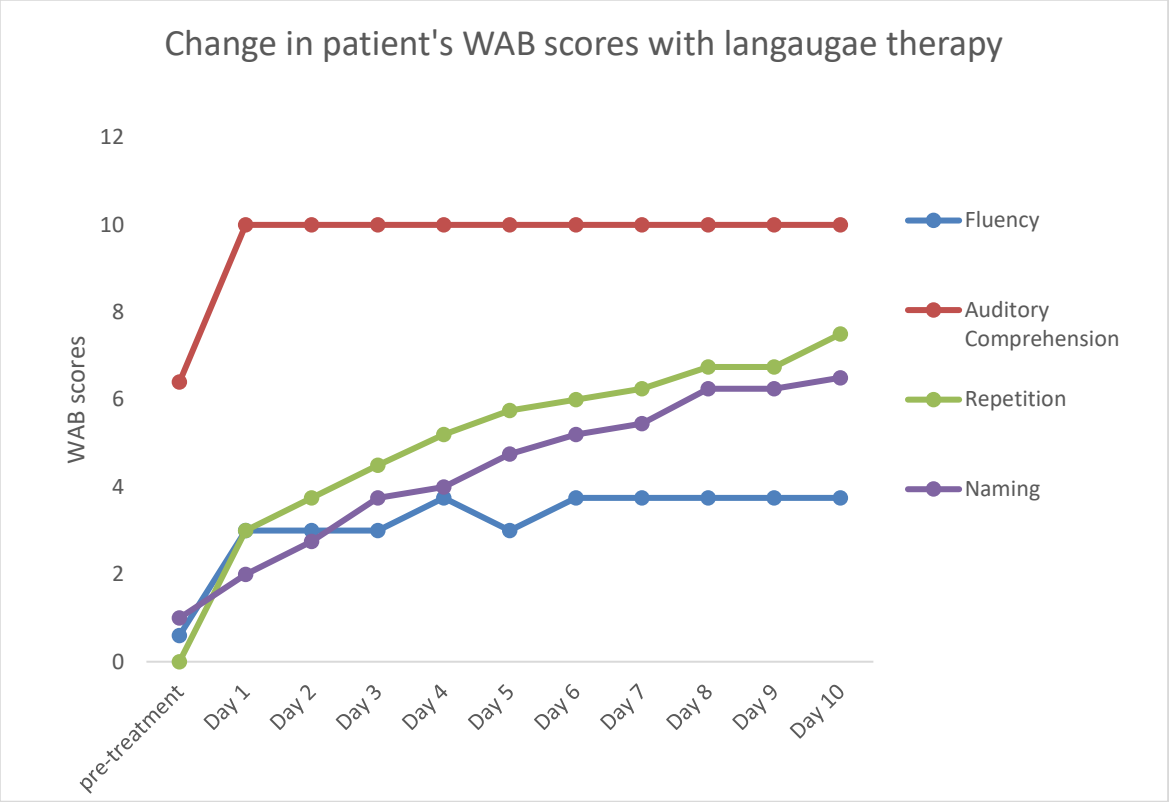


Figure 1. Improvement in WAB scores in different domains of language with the language therapy provided to the patient from day 1 to day 10

The variables in the study (all except auditory comprehension since it had unanimous values on all days) were initially evaluated for their distribution pattern using Kolmogorov-Smirnov test. Most of the parameters (days of therapy, repetition and naming) were normally distributed. However, fluency was not found to be normally distributed. The progression of therapy was correlated with patient outcomes. All correlations were found to be significant ($p<0.01$) strong positive correlations. The correlogram depicting same has been depicted in the following diagram. All domains of language i.e. comprehension, repetition, naming and fluency improved significantly over time with the language therapy intervention.

It can be seen that auditory comprehension improved spontaneously from the day the patient was assessed till the day the language therapy was completed in both Ao Naga and English. The repetition and naming ability of the patient improved with progression the days of therapy in both the languages. Positive reinforcement (verbal appreciation) was provided whenever the patient could successfully produce the targeted responses in any of the languages. Fluency improved with improved MLU (2-3 words) and intelligibility, where the patient was able to respond to the spontaneous speech with proper information content regarding the relevant questions asked. Post therapy (on the 10thday) the patient responded in L1and L2 or at times used words from both the languages. Neologistic paraphasia, following the word was observed while answering long sentences mostly in L1 and sometimes in L2 as well. Phonemic Paraphasia was also observed with persevarative, epenthesis and substitution errors in L1 and L1. Naming

improved but difficulties still persisted and cueing was seen to be helpful for eliciting response in the patient in both L1 and L2. The correlogram given below depicts the language therapy progression and the language domains (Fig. 2)

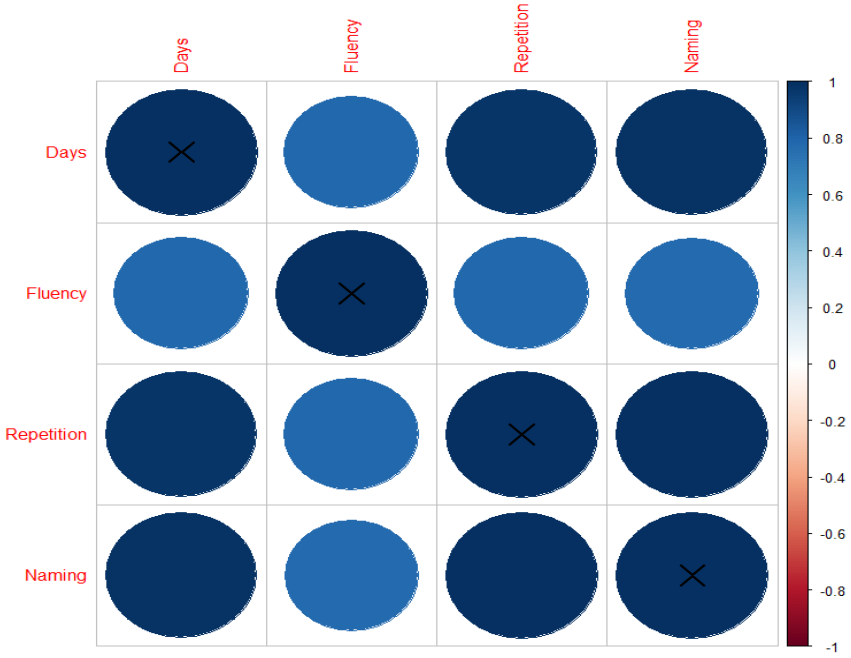
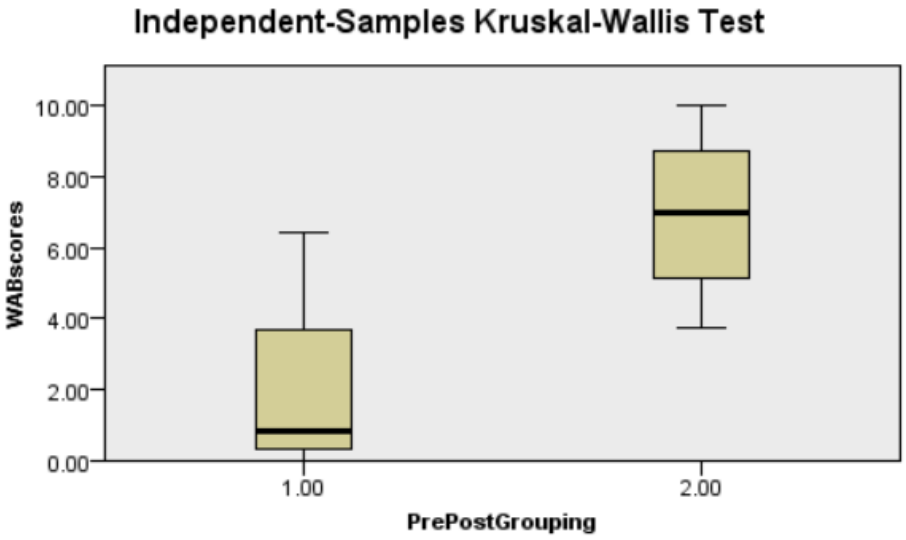


Figure 2. Correlogram depicting correlation between language therapy progression and language domains

The pre- and post- language therapy WAB scores were significantly different, in all the four domains of language; based on non-parametric Kruskal-Wallis ANOVA (test-statistic= 4.083, df=1, $p<0.05$), the results have been represented in the following Figure 3.



Total N	8
Test Statistic	4.083
Degrees of Freedom	1
Asymptotic Sig. (2-sided test)	.043

1. The test statistic is adjusted for ties.

Figure 3. Non-parametric Kruskal-Wallis ANOVA depicts significant improvement in pre and post therapy WAB scores

The WAB was administered post-therapy and the patient scored 7.5 for spontaneous speech,10in comprehension,6.5 in naming and 6.5 in repetition task respectively. When the Aphasia Quotient (AQ) was calculated using the formulae

AQ = (Spontaneous + Comprehension ÷ 20 + Repetition ÷ 10 + Naming ÷ 10) × 2,

the score was obtained was 39.8 which determined Severe Aphasia. Post-Therapy WAB scores are given in Table 3.

Table 3
Post-therapy WAB scores in the four domains

	Fluency	Auditory comprehension	Repetition	Naming
Maximum score for Broca's aphasia	0-4	4-10	0-7.9	0-8
Patient score	3.75	10	7.5	6.5

The patient was later kept in the criteria of Transcortical Motor Aphasia because more fluent speech output was observed with respect to words, phrases and sentences than spontaneous speech in both L1 and L2.The patient had persistent difficulty in initiating speech and had echolalia and naming difficulties as well (14).The pre and post-therapy WAB scores with respect to AQ is given in Table 4.

Table 4
Pre and Post therapy WAB scores with respect to AQ scores

Wab scores	Fluency	Auditory comprehension	Repetition	Naming	Aq
Pre-therapy	12	6.4	0	1	24.84 (very severe)
Post-therapy	18	10	7.5	6.5	39.8 severe)

The patient was provided with Home Training materials (as they decided to head back to their native place) for continuing the language therapy to improve. Inference as non-fluent Aphasics are reported to have better inference than fluent aphasics (Wright et. al,2004).

4. Discussion (or Discussion and conclusion)

The aim of the study was to understand the understand the effectiveness of early intervention of language therapy in bilingual aphasic patient speaking Ao as the first language (L1) and English as the second language (L2).

In contrast to monolinguals, bilingual aphasic patients have a higher probability to improve their processing speed during rehabilitation, resulting in a shortening of the Mismatch Negativity (MMN) latency over time, which sometimes progresses toward the normative values (De Letter et. al,2021).

Across the board, bilingual speakers with post-stroke aphasia performed better in L1 than in L2, according to a study; however, the extent of this difference varied depending on when L2 was learned: bilinguals who learned L2 before the age of seven demonstrated similar performance in both languages, while bilinguals who learned L2 after the age of seven demonstrated better performance in L1 than in L2. These strong results were somewhat mitigated by premorbid proficiency and frequency of use (Kuzmina et. al,2019).

There are studies which supports the fact that L1 was better preserved in Aphasics than L2, depicting that early learned language is more resistant to brain injury (Ribot et. al,1887; Abutalebi et. al,2007). The other study affirm that language production in bilinguals is a dynamic process involving cortical and sub cortical structures that use inhibition to resolve lexical competition and choose the intended language, and that the neural representation of a L2 converges with the representation of that language learned as L1(Abutalebi et. al,2007).

Few studies also highlight the fact that the co-relation between language proficiency and language use as well. The speaker that uses the language regularly are said to be more proficient in that and thus may be more efficient in that language with respect to usage, linguistic proficiency and similarity (Goral et. al,2010). Whereas, few studies also focus on the fact that the proficiency maybe greater in L2 because of its greater usage and early acquisition of L2 may play an important factor for the same (Kuzmina et. al, 2019). But at the same time, the study also highlighted the little role the language proficiency plays a great role in language representation and processing in the bilinguals but usage of L2 in educational aspects but prove to be an additional proficiency for L2.

Then another factor to focus on is the fact that the similarity between L1 and L2 can influence the compatibility in bilingual aphasics because of common lexico-semantic representation and other grammatical aspects in both the languages. But few studies provide contrasting results for this hypothesis inferring that there might be a very little possibility of the similarity between L1 and L2 (Munoz, 2003; Alsando, 2010).

The age of language acquisition of the L2 may also play an important role and the individual might have more ability in potentially processing the L2 (Giussani, 2007). Also, a study considered the age 7 year as a 'natural-breaking point' as the child starts learning L2 at the school age (Kuzmina, 2019). Similarly, another study also considered age 6 and bilingualism was considered as advantage of cognitive control functions in adults (Lehtonen, 2018).

There are six distinct patterns that matched the most often seen language characteristics of bilingual aphasia recovery. Recovery may be classified as either selective when only one damaged language recovers, differential when stronger recovery is shown in one over the other, mixed when inappropriate LM takes place, or parallel when both impaired languages improve to a comparable degree and simultaneously. Additionally, rehabilitation may be antagonistic when the recovery of L1 and L2 follows different patterns and one language improves while the other regresses, or sequential when the recovery of one language is completed before the other.

Here, in the present study the patient had similar kind syntactical and semantical errors in both L1 and L2.The patient showed greater comprehension and while undergoing intervention ,the patient was more reluctantly dependent on L2 rather than L1.Patient was able to comprehend instructions in L2 than L1 and naming errors were less prevalent in L2 than L1.The possible reason behind this can be considered as language proficiency in L2 as well as early language acquisition in L2(Manuel et. al,1994).

Another important factor to be highlighted here in that Ao Naga(L1) belongs to the Tibeto-Burman Language family which is spoken in Mokochung district of Nagaland state of North Eastern India (Mukherjee, 2020; Coupe, 2007). The Ao Naga lacks individual script and is dependent on L2 (English)which is also the official language in the state of Nagaland. This draws inference to the fact mostly used and preferred language for the patient since childhood. The schooling of the patient started in L2 rather than L1 and was widely used for communication before stroke.

Another possible reason to highlight the efficiency of the patient in L2 can be considered due to Language Transfer Theory which maybe positive and negative, playing an important role in L2. Positive Language transfer is basically the influence of L1 concept helps in acquisition of L2 and negative Language Transfer is L1interrupting the acquisition of L2 (Coupe,2007).

Moreover, the recovery of L1 and L2, parallel pattern was observed, maybe due to the age, proper home-training and the therapy being provided in both L1 and L2 by the care-giver and SLP. The cognitive deficits or probability of having poor memory skills was less severe than the geriatric population may also have contributed in the good prognosis in the patient.

The Revised Hierarchical model of bilingual representation that is said to represent two different levels of representation (lexical and conceptual) and thus accommodating independent lexical representations for both L1 and L2 but with similar conceptual representation, might have also played a significantly role in emerging of the L1 and L2 in the patient (Wang et. al, 2010)

The limitation of the study is that more samples are required to understand the lexical representation and grammatical similarity in the bilinguals knowing both Ao Naga and English; whether parallel recovery will be observed with other kind of Aphasias.

Another perspective to be considered in the recovery of language functions following left gangliocapsular injury in Broca's aphasia most likely reflects reorganization within a distributed cortico-subcortical network rather than restitution within a single locus. Anatomical evidence from diffusion tractography demonstrates direct corticostriatal and cortico-thalamic connections linking Broca-region cortex with basal ganglia nuclei, providing a structural substrate for coordinated subcortical and frontal plasticity (Ford et al., 2013; Booth et al., 2006). Longitudinal studies of pure subcortical aphasia reveal substantial behavioural recovery accompanied by reactivation of perilesional left frontal cortex, and in some cases contralesional recruitment, suggesting that cortical reorganization can proceed in parallel with subcortical recovery (Lahiri et al., 2020; Thompson & den Ouden, 2008). Furthermore, large treatment-based fMRI investigations demonstrate that therapy induces domain-specific recruitment of ipsilesional frontal networks, reinforcing the view that functional gains emerge from dynamic changes across both gangliocapsular and left frontal nodes (Barbieri et al., 2023). Recent lesion–disconnection analyses also support a distributed network model of Broca's aphasia, in which recovery depends on the integrity and plasticity of interconnected cortical and subcortical components (Pracar et al., 2025).

5. Conclusion

The study concludes that in bilingualism aphasia, both the L1 and L2 can emerge at the same time during the spontaneous recovery stage. The L2 might in fact, contribute more in recovering of the L1 based on usage, proficiency and usage and exposure. The similarity in lexico-semantic structures of both the language may also help in recovery of both the L1 and L2. Early intervention, age, and proper home-training have also helped in the effectiveness of the therapeutic aspects. Moreover, the therapeutic

strategies provided during the intervention phase were also important in highlighting the fact of positive recovery. As the therapeutic strategies mainly consisted of the fact of strengthening the lexicon, priming and semantic aspects of both the L1 and L2 in the mental network, which might have help in improving the language structure in both L1 and L2. Instead of approaching on the elaborative way of intervention, the basics of the morpho-semantic structure should be considered and later on morpho-syntactic structure as a part of the lexical architecture should be focused upon. Moreover, the phonological therapy in aphasics may help in strengthening the mapping between the semantic and phonological lexicon based on various degree cognitive and linguistic difficulties (Waldron et. al, 2011). In addition to pattern of recovery and therapeutic strategies, the site of lesion in the brain and severity and type of aphasia also play a pivotal role in determining the course and outcome of bilingual recovery.

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KD- conceptualization, writing of original draft**, HBN-**resources and project administration**, RM-**statistical analysis **DV-**writing of draft and editing, methodology**, DD-** writing of draft and editing, methodology

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References

Abutalebi, J., & Green, D. (2007). Bilingual language production: The neurocognition of language representation and control. *Journal of neurolinguistics*, *20*(3), 242-275. https://doi.org/10.1016/j.jneuroling.2006.10.003

Ansaldo, A. I., Marcotte, K., Scherer, L., & Raboyeau, G. (2008). Language therapy and bilingual aphasia: Clinical implications of psycholinguistic and neuroimaging research. *Journal of Neurolinguistics*, *21*(6), 539-557. https://doi.org/10.1016/j.jneuroling.2008.02.001

Ansaldo, A. I., Saidi, L. G., & Ruiz, A. (2010). Model-driven intervention in bilingual aphasia: Evidence from a case of pathological language mixing. *Aphasiology*, *24*(2), 309-324. https://doi.org/10.1080/02687030902958423

Barbieri, E., Thompson, C. K., Higgins, J., Caplan, D., Kiran, S., Rapp, B., Parrish, T., et al. (2023). Treatment-induced neural reorganization in aphasia is language-domain specific: Evidence from a large-scale fMRI study. Cortex, 159, 75–100. https://doi.org/10.1016/j.cortex.2022.11.008

Beaton, A. A., & Wyn Davies, N. (2007). Semantic errors in deep dyslexia: Does orthographic depth matter?. *Cognitive Neuropsychology*, *24*(3), 312-323. DOI: 10.1080/02643290701251957

Booth, J. R., Wood, L., Lu, D., Houk, J. C., & Bitan, T. (2006). The role of the basal ganglia and cerebellum in language processing. Brain Research, 1133(1), 136–144. https://doi.org/10.1016/j.brainres.2006.11.074

Coupe, A. R. (2007). *A grammar of MongsenAo*. Mouton de Gruyter. https://doi.org/10.1515/9783110198522

De Letter, M., Cocquyt, E. M., Cromheecke, O., Criel, Y., De Cock, E., De Herdt, &Duyck, W. (2021). The protective influence of bilingualism on the recovery of phonological input processing in aphasia after stroke. *Frontiers in Psychology*, *11*, 553970. https://doi.org/10.3389/fpsyg.2020.553970

Edmonds, L. A., Nadeau, S. E., & Kiran, S. (2009). Effect of Verb Network Strengthening Treatment (VNeST) on lexical retrieval of content words in sentences in persons with aphasia. *Aphasiology*, *23*(3), 402-424. DOI: 10.1080/02687030802291339

Ford, A. A., Triplett, W., Sudhyadhom, A., Gullett, J., McGregor, K., FitzGerald, D. B., Mareci, T., White, K., & Crosson, B. (2013). Broca's area and its striatal and thalamic connections: A diffusion-MRI tractography study. Frontiers in Neuroanatomy, 7, Article 8. https://doi.org/10.3389/fnana.2013.00008

Giussani, C., Roux, F. E., Lubrano, V., Gaini, S. M., & Bello, L. (2007). Review of language organisation in bilingual patients: what can we learn from direct brain mapping?. *Acta Neurochirurgica*, *149*, 1109-1116. DOI: 10.1007/s00701-007-1266-2

Goral, M., Levy, E. S., & Kastl, R. (2010). Cross-language treatment generalisation: A case of trilingual aphasia. *Aphasiology*, *24*(2), 170-187. DOI: 10.1016/j.bandl.2007.07.116

Hernandez, A. E., Dapretto, M., Mazziotta, J., & Bookheimer, S. (2001). Language switching and language representation in Spanish–English bilinguals: An Fmristudy. *NeuroImage*, *14*(2), 510-520. DOI: 10.1006/nimg.2001.0810

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of memory and language*, *33*(2), 149-174.https://doi.org/10.1006/jmla.1994.1008

Kuzmina, E., Goral, M., Norvik, M., & Weekes, B. S. (2019). What influences language impairment in bilingual aphasia? A meta-analytic review. *Frontiers in psychology*, *10*, 445.doi: 10.3389/fpsyg.2019.00445

Lahiri, D., Ardila, A., Dubey, S., & Ray, B. K. (2020). A longitudinal study of aphasia due to pure sub-cortical strokes. Annals of Indian Academy of Neurology, 23(Suppl 2), S109–S115. https://doi.org/10.4103/aian.AIAN_475_20

Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., De Bruin, A., &Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning in adults? A meta-analytic review. *Psychological bulletin*, *144*(4), 394. DOI: 10.1037/bul0000142

Li, R., Li, W., & Kiran, S. (2021). Effect of Mandarin Verb Network Strengthening Treatment (VNeST) in Mandarin-English bilinguals with aphasia: A single-case experimental design. *Neuropsychological rehabilitation*, *31*(8), 1224-1253. DOI: 10.1080/09602011.2020.1773278

Mukherjee K., Linguistic Ecology and Ao Naga. IBJCAL Vol 2 Issue [Internet]. 2020 Jan 1 [cited 2024 Feb 16]; Available from: https://www.academia.edu/44720721/Linguistic_Ecology_and_Ao_Naga.

https://www.indianadibasi.com/journal/index.php/ibjcal/issue/view/3VOLUME-2, ISSUE-1, ibjcal2020M04, pp. 35-52

Marte MJ, Carpenter E, Scimeca M, Russell-Meill M, Peñaloza C, Grasemann U, Miikkulainen R, Kiran S. Machine Learning Predictions of Recovery in Bilingual Poststroke Aphasia: Aligning Insights With Clinical Evidence. Stroke. 2025 Feb;56(2):494-504. doi: 10.1161/STROKEAHA.124.047867. Epub 2025 Jan 2.

Muñoz, M., & Marquardt, T. (2003). Picture naming and identification in bilingual speakers of Spanish and English with and without aphasia. *Aphasiology*, *17*(12), 1115-1132.https://doi.org/10.1080/02687030344000427

Penn, C., Frankel, T., Watermeyer, J., & Russell, N. (2010). Executive function and conversational strategies in bilingual aphasia. *Aphasiology*, *24*(2), 288-308. DOI:10.1080/02687030902958399

Pracar, A. L., Biondo, N., Dronkers, N. F., & Ivanova, M. V. (2025). The neuroanatomy of Broca's aphasia. Frontiers in Language Sciences. https://doi.org/10.3389/flang.2025.1496209

Puente, A. E., & McCaffrey, R. J. (Eds.). (2013). *Handbook of neuropsychological assessment: A biopsychosocial perspective*. Springer Science & Business Media.

Ribot T. Diseases of memory. Appleton; 1887. 274 p.

Sheppard, S. M., & Sebastian, R. (2021). Diagnosing and managing post-stroke aphasia. *Expert review of neurotherapeutics*, *21*(2), 221-234. DOI: 10.1080/14737175.2020.1855976

Thaut, M. H., McIntosh, G. C., & Hoemberg, V. (2015). Neurobiological foundations of neurologic music therapy: rhythmic entrainment and the motor system. *Frontiers in psychology*, *5*, 1185. https://doi.org/10.3389%2Ffpsyg.2014.01185

Thompson, C. K., & den Ouden, D.-B. (2008). Neuroimaging and recovery of language in aphasia. Current Neurology and Neuroscience Reports, 8(6), 475–483. https://doi.org/10.1007/s11910-008-0076

The Assessment of Bilingual Aphasia | Michel Paradis, Gary Libben | Ta [Internet]. https://doi.org/10.4324/9781315802138

Wang, X. (2010). The bilingual lexicon: models and implications. *Language and cognition interface: State of the art. Publisher: LINCOM Europa.*

Waldron, H., Whitworth, A., & Howard, D. (2011). Therapy for phonological assembly difficulties: A case series. *Aphasiology*, *25*(4), 434-455. DOI: 10.1080/02687038.2010.494830

Wright, H. H., & Newhoff, M. (2004). Inference revision processing in adults with and without aphasia. *Brain and language*, *89*(3), 450-463.https://doi.org/10.1016/S0093-934X(03)00469-3

Yan, Z., Wei, D., Xu, S., Zhang, J., Yang, C., He, & Jia, J. (2022). Determining levels of linguistic deficit by applying cluster analysis to the aphasia quotient of Western Aphasia Battery in post-stroke aphasia. *Scientific Reports*, *12*(1), 15108. DOI: 10.1038/s41598-022-17997-0