

Default Strategy Used by Broca's Aphasic Patient During a Sentence Comprehension

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Abstract: *This paper reports on a study on the use of default strategy by Broca's aphasic patient during a speech comprehension using sentence to picture matching test. The test was undertaken at The National Stroke Association of Malaysia (NASAM), Petaling Jaya, Malaysia. The current study employs the theory of Grodzinsky's (1990) Trace Deletion Hypothesis (TDH) as an explanation for the Broca aphasic patient's ability to comprehend active and passive sentences using a default strategy. TDH also characterises Broca aphasic patient as a good comprehender of active sentences and as a bad comprehender of passive sentences. Christensen's (2001) Sentence to Picture Matching Test has been adopted in this study to investigate the Broca aphasic patient's comprehensibility of both active and passive sentences. The findings of this study support the account of TDH in which Broca's aphasic patient has been using the default strategy during their active and passive sentences comprehension process and due to the usage of the strategy, the patient is considered as a good comprehender of active sentences and a bad comprehender of passive sentences. The default strategy used by the Broca's aphasic patient has affected their understanding of the sentence structures overall.*

Keywords: Default Strategy, Trace Deletion Hypothesis (TDH), Broca's Aphasic, Sentence Comprehension, Sentence to Picture Matching Test

1. Introduction

1.1 Background to the Study

This study is an investigation of the comprehensibility of a Broca aphasic patient on active and passive sentences. Christensen's (2001) Sentence to Picture Matching Test (SPMT) was used to determine the comprehensibility of the Broca aphasic patient by adopting Grodzinsky's (1990) Trace Deletion Hypothesis (TDH) as the theoretical foundation. A principle called the Theta Criterion (Chomsky, 1981) is employed as an explanation for the active and passive sentences processing of the Broca aphasic patient. This principle is in line with theta theory in which Noun Phrases (NPs) in sentences are assigned thematic roles, known as theta roles, such as agent (the 'doer' of the action specified by the predicate, e.g., 'the boy' in "The boy kissed the girl from Sweden") or theme (the entity affected by the action). Caramazza and Zurif (1976) suggest that Broca's aphasics fail to comprehend semantically reversible sentences, in which NPs in active and passive sentences can act equally well as an agent or a theme. Their findings of Broca's patients' difficulty in understanding semantic reversible sentence structures have led to the term "overarching agrammatism," which refers to the fact that the grammatical constituents of language are not employed in comprehension of sentences.

One of the most influential theories on Broca aphasic comprehension is Grodzinsky's (1990) Trace Deletion Hypothesis (TDH). This theory is fundamental to the study on the different types of sentences that can be comprehended by Broca's aphasics especially those having semantic reversible sentence structures. The theory characterizes agrammatic patients as good comprehenders of active sentences but as bad comprehenders of passive sentences. This study is an attempt to investigate the performance of Broca's aphasic patient when comprehending active and passive sentences and to explain the use of default strategy (R(referential)-Strategy) during the sentence comprehension. This strategy is one of the independent claims of Grodzinsky's (1995) Trace Based Account (TBA) which assigns a theta role to the NPs by their linear order. This theta-assignment is carried out in accordance with Jackendoff's (1971) Thematic Hierarchy (Teomiro Garcia, 2005).

In regular comprehension of passive sentences, whenever a NP shifts from the position, its theta roles is transferred by means of the trace that the NP leaves behind. However, in agrammatic representation, that trace is no longer operative, and the theta role cannot be transferred to the moved NP (Su, Lee and Chung, 2001). This phenomenon can be further supported by Grodzinsky's (1990) TDH in which the hypothesis states that all traces that are in theta position are deleted at the surface structure in agrammatic linguistic representation. According to Chomsky (1981), arguments in sentence structures are assigned to one appropriate theta roles by considering the predicate in a sentence. Since traces of moved NPs are deleted (or it is not visible to theta-assignment), Broca aphasic patients would employ a default strategy known as R-Strategy in which they would assign the first NP they encounter in a sentence as an agent. Since NPs in active and passive sentences can act equally well as an agent or a theme, the comprehension of active sentences (Subject-Verb-Object) can be comprehended effectively by Broca aphasic patients. So, to investigate the employment of the default strategy (R-Strategy), a comprehension test known as Sentence to Picture Matching Test (SPMT) designed by Christensen (2001) has been adopted in this study to determine an agrammatic patient's comprehensibility and to explain the use of default strategy during the sentence comprehension as mentioned in Grodzinsky's (1995) TBA using active and passive semantic reversible sentences as stimulus.

1.2 Statement of the Problem

The main symptom of Broca's aphasia is agrammatism. This term is referred to an effortful, non-fluent, hesitating, and telegraphic speech with lost pattern of rhythm observed in some subjects after brain damage to frontal-temporal areas (Jakobson, 1941). As Broca's aphasia is best known for the non-fluent, telegraphic pattern of speech, the comprehension problems associated with this syndrome are less noticeable and harder to detect. However, Caramazza and Zurif (1970) showed that Broca's aphasic exhibit different pattern of comprehension of "semantically reversible" and "semantically irreversible" sentences. These findings further research on the syntactic capacity of Broca's aphasics, which led to the formulation of the Grodzinsky's (1990) TDH, one of the most influential and controversial claims in neurolinguistics.

The failure to detect comprehension deficits in agrammatic patients extends to comprehension of more complex sentence constructions such as passives and object relatives. Caramazza and Zurif (1976) and Grodzinsky (2000) studies have shown that certain syntactically complex sentence types are difficult in aphasic comprehension most prominently object relative clause and passives in English. The comprehension of these sentence types is in sharp contrast with their non-problematic counterparts, subject relative clause, and active sentences. Since the findings of Caramazza and Zurif (1970) led to formulation of Grodzinsky's (1990) TDH,

Teomiro Garcia (2005) claimed that TDH is inappropriate, especially when there is a claim that all traces were predicted to be deleted from surface structure.

In the Malaysian context, there are very few studies done, specifically on aphasia. However, a few studies have been conducted by students from Universiti Kebangsaan Malaysia and Universiti Sains Malaysia that are more scientific in which most of the students are from the field of Speech Science and Health Science and basically focused more on Malay speaker that diagnosed from aphasia (Ahmad Shahime, 2004; Chiang, 2005; Tuin, 2009; Muhammad Sabri, 2011; Hassan, 2008; Fong, 2010). Since there were limited studies on aphasia specifically in English language, it will be interesting to see whether previous findings of aphasia especially on Grodzinsky's (1990) TDH is applicable among the bilingual aphasics whose second language is English.

1.3 Research Questions

This study is undertaken to seek the answer to the following research questions:

- a) What is the percentage obtained by the Broca aphasic patient in the Sentence to Picture Matching Test (SPMT) for the comprehension of active and passive sentences?
- b) Does the Broca's aphasic patient in the study use the default strategy during the sentence comprehension of active sentences and passive sentences?

2. Literature Review

2.1 Broca's Aphasia

Trousseau (1864) introduced the term aphasia, lack of communication by means of language (a – _lack' + phasia _word'), to describe an acquired language impairment caused by damage to the brain in the hemisphere responsible for communication. According to the National Institute on Deafness and Other Communication Disorders (2010), aphasia is a neurological disorder that results from damage to the language areas of the brain, and it is typically caused by a head injury, brain tumor or stroke. Aphasia is generally subdivided into three broad categories: expressive aphasia, receptive aphasia, and global aphasia. Expressive aphasia, also called Broca's aphasia or non-fluent aphasia, results from damage to the frontal lobe of the brain and is characterized by an inability to communicate through well-formed utterances in speech or grammatical sentences in writing. Expressive aphasics generally have good comprehension but are only able to produce short sentences (National Institute on Deafness and Other Communication Disorder, 2010; National Institute of Neurological Disorders and Stroke, 2012).

Damage to Broca's Area, i.e. Brodman's area 44 and 45 (also called the left inferior frontal gyrus) and vicinity that refers to three areas, the operculum, which is the lower part of the motor strip, just to the right of Broca's area, the insula, which is a group of convolutions at the base of the Sylvian fissure to the below to the right of Broca's area and the subjacent white matter, beneath the cortex towards the inner parts of the brain results in Broca's aphasia, which is a drastic loss of speech fluency making speech effortful and telegraphic. (Sobotta & Becher, 1975). Figure 1 below shows the Brodman's area and vicinity in human brain.

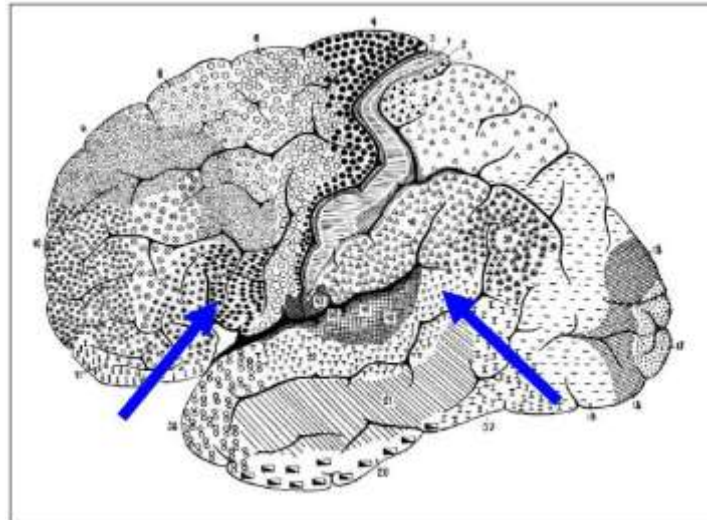


Figure 1: Brodman's areas. The left arrow points to area 44, Broca's area. The right arrow points to the posterior (rightmost) part of area 22 – this posterior part is Wernicke's area. The symbol indicates cortical cell structures, which roughly coincide with functional areas. (Source: Sabotta & Becher, 1975, 6)

Damasio (1992) claimed that Broca's aphasics are aware of their impairment and are often depressed especially when their inability to repeat sentences they hear and unable to repeat the types of sentences that they fully understand, much to their own surprise and dismay.

Avrutin (2001) clarified that the utterance produced by Broca's aphasic is typically reduced in length, and it takes patients significantly longer to express their thoughts, or to describe pictures and have severe problems with word findings, which can at least partially account for their elliptical utterances and poor naming.

Broca (1861) defined Broca's area was thought to be responsible for speech production and until the late 70's, it was commonly thought that Broca's suffered only from impaired language production, on the basis of their agrammatic speech. However, Camarazza and Zurif (1976) showed that their comprehension was impaired as well. This can be further proven by many others Grodzinsky (1995, 2000; Bastianse et al. 2001; Burchert et al. 2003) have shown that agrammatism also affects language comprehension capacity.

2.2 Previous Studies on Aphasia in Malaysia

Ahman Shahime (2004) conducted a case study to analyse conversations between student clinicians with aphasic patients. The analysis was done using Supporting Partners of People with Aphasia in Relationship & Conversation (SPPARC). The main objective of the study was to describe features of conversation between student clinicians and aphasic patients based on three aspects in SPPARC which are problem and repair, turns and sequence, and overall conversation. Four student clinicians were involved in this study and aphasic patient were divided into two groups which are a group of moderate aphasia and a group of severe aphasia. Results showed that student clinicians take a lot of control in conversation in terms of taking turns at talk, initiating topics, and putting a lot of demands toward the aphasic patient.

Chiang (2005) conducted a case study on linguistic analysis of a Malay agrammatic speaker. This study described the language grammatical pattern of Malay speaking agrammatic aphasia in conversational context. Language samples of subjects' spontaneous speech was elicited through free conversation covering different conversational settings such as with different conversation partner, different topic, and a narrative task. The recording was carried out in the

home of the subject, across 4 sessions using audio recording equipment. Language samples were then transcribed and analysed according to the Language Assessment Remediation and Screening Procedures (LARSP). Findings revealed that at a single element utterance, the major sentence types were mainly nouns. At more than one element level, results show a restricted syntactic profile, with an unbalanced distribution concentrating at 2- element utterances at stage II, and complex sentences were few.

Hassan (2008) with the aim to describe and outline factors affecting sentence comprehension in Malay native speakers with aphasia. The factors include the reversibility of sentences, the type of sentences—active and passive reversible, the verb classes used as well as the complexity of the sentences based on the number of arguments presented in a given sentence. Six normal individuals and six individuals with aphasia were recruited for the study and they were being aged, education and L1-matched. These two groups were given sentence-picture matching test as the chosen procedure employed to test on the factors mentioned above. Findings of this study revealed that individuals with aphasia have poorer understanding of active and passive reversible sentences than that of normal.

Jalil (2011) described the development of a semantic battery in Malay among the Malay-speaking adults with aphasia. The battery was developed in Singapore using a cognitive neuropsychological model of language representation and administered to three cohorts of neurologically intact adults with Malay as their first language. Twelve subtests (6 each for nouns and verbs) cover input and output modalities (listening, reading, speaking, and spelling) and all the picture referents were standardized locally. From an initial pool of 130 items, an item analysis revealed that 52 nouns and 45 verbs (97 words) achieved > 80% accuracy across subtests for first language speakers of Malay. The findings for this study revealed that educational background influenced processing abilities, especially reading and spelling skills. The Malay Semantic Battery provides an example of how culturally and linguistically appropriate assessment tools can be developed from first principle at minimal cost.

2.3 Theoretical Foundation of the Study

2.3.1 Trace Deletion Hypothesis

One of the most influential theories on agrammatic comprehension is the Grodzinsky's (1990) Trace Deletion Hypotheses (TDH) that characterizes agrammatic patients as good comprehenders of Subject Verb Object (SVO) sentence structure, the active sentence but as bad comprehenders of semantic reversible Object Verb Subject (OVS) sentence structure, the passive sentences. This theory is fundamental to the present study to study the different types of sentences that can be comprehended by Broca's aphasic patient. In agrammatism, traces are deleted, and patients assign thematic roles to non-thematic positions, relying on a Default Strategy. Grodzinsky (1990) characterized agrammatism by the following phenomena:

a. Trace Deletion

All traces are deleted from S-structure level

b. Default Strategy (R-Strategy)

NPs that do not receive a theta role syntactically are assigned a default theta-role. Or, stated in terms of GB Theory: NPs in non-thematic positions are under the scope of some Default Principle that associates a theta role to every non-thematic position. (p.83)

2.3.2 Theta Theory

Thematic roles, known as theta-roles or Θ -roles, such as agent (the one purposely doing or initiating the action expressed by the predicate) or theme (the entity affected by the action or

state expressed by the predicate) are assigned to respective arguments/NPs in a sentence. Chomsky's (1981) Theta Criterion principle ensures that all arguments are assigned to one theta roles and all theta roles of a predicate are assigned to suitable structures in a one-to-one relation.

2.3.3 Conceptual Framework of the Study

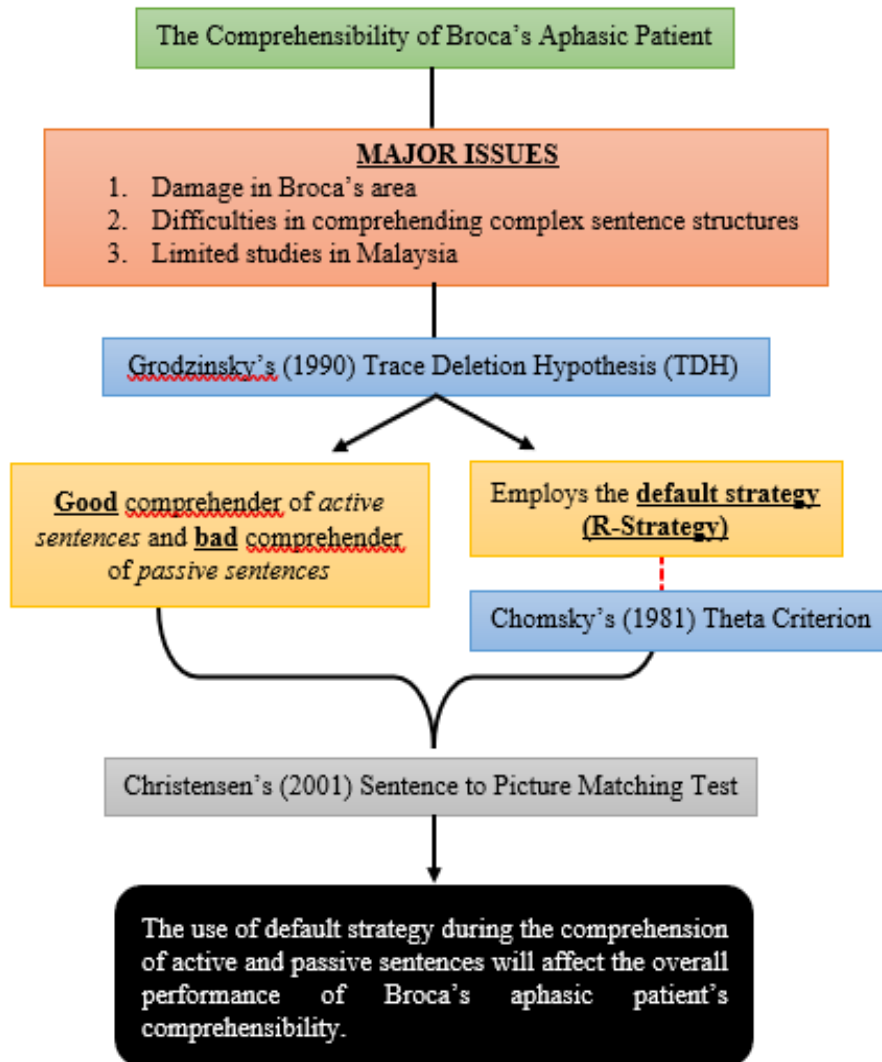


Figure 2: The Conceptual Framework of the Study

Figure 2 shows the conceptual framework of the study. Grodzinsky's (1990) Trace Deletion Hypothesis (TDH) and Chomsky's (1981) Theta Criterion are used as the theoretical framework for the study. A comprehension test, Christensen's (2001) Sentence to Picture Matching Test (SPMT) is adopted to determine the comprehension ability of an agrammatic patient in which Chomsky's (1981) Theta Criterion would be used as an explanation for agrammatic patient's comprehension ability to determine an agrammatic patient's comprehension ability and to explain the use of default strategy (R-Strategy) during the sentence comprehension process as mentioned in Grodzinsky's (1995) TBA using semantic reversible sentences of active and passive sentences as stimulus. The two types of sentence construction are constructed; Active sentences, Subject-Verb-Object (SVO) and Passive sentences, Object-Verb-Subject (OVS) are formed into semantically reversible sentences.

3. Methodology

Eight sets of pictures that correspond to the two interpretations of semantic reversible sentence are devised in a comprehension test known as Sentence to Picture Matching Test (SPMT) designed by Christensen (2001). This comprehension test is used to determine the comprehension ability of a Broca aphasic patient. Since the research design is a case study, one Broca’s aphasic patient from the National Stroke Association of Malaysia (NASAM), Petaling Jaya was selected as a sample for this study. In this comprehension test, the patient was asked to see a set of pictures and select one picture that best portrays the meaning of the presented sentence. This type of comprehension test was used by numerous researchers in their studies to investigate agrammatic patient’s comprehensibility (Caramazza and Zurif 1967; Heilman and Scholes 1976; Schwartz *et. al* 1980; Gallaher and Canter, 1982; Sherman and Schweickert, 1989; Yi-Ching, 2007).

Table 1 below is an example of semantically reversible sentences for active sentences and passive sentences used in this study:

Table 1: Semantically Reversible Sentences for Active and Passive Sentences

Example of Sentences	
Active (SVO)	<i>the girl pushes the boy</i>
Passive (OVS)	<i>the boy nushes the girl</i>
	<i>the girl was pushed by the boy</i>
	<i>the boy was pushed by the girl</i>

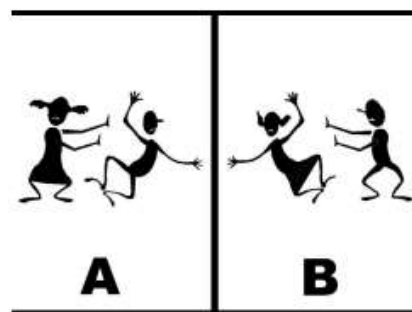


Figure 3: Picture of —the girl pushes the boy (A) and —the boy pushes the girl (B)
 Source: (Christensen, 2001)

3.1 Data Analysis

Quantitative data for this study is tabulated numerically by calculating the average percentage obtained by the Broca aphasic patient in the test based on sentence types and correct sentences identification. The average percentage of the correct and wrong answers is created based on the first and second attempt of SPMT and the Broca aphasic patient’s performance is identified.

Qualitative data is collected by analyzing the deep structure and surface structure of a sentence to identify whether the patient used the default strategy (R-Strategy) during the sentence comprehension as mentioned in Grodzinsky’s (1995) TBA.

4. Results and Discussion

4.1 The percentage obtained by the Broca aphasic patient in the SPMT

Table 2, Figure 4, and Figure 5 below show the Broca aphasic patient’s average percentage and performance.

Table 2: The Broca Aphasic Patient’s Average Percentage

Sentence Types	Correct Answer(s)		Patient’s Findings	
	1 st attempt	2 nd attempt	Average Percentage (%)	Performance
SVO – Active Sentences	15/16	14/16	91	Good Comprehender
OVS – Passive Sentences	5/16	3/16	25	Bad Comprehender

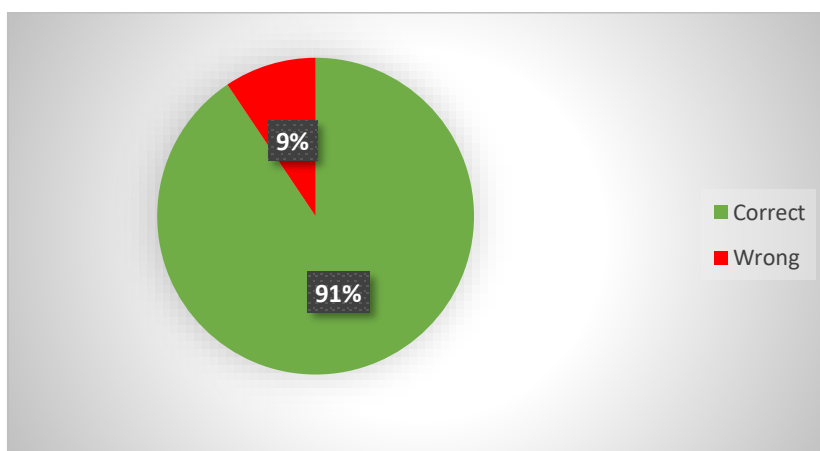


Figure 4: The Broca Aphasic Patient’s Average Percentage in Comprehending Active (SVO) Sentences.

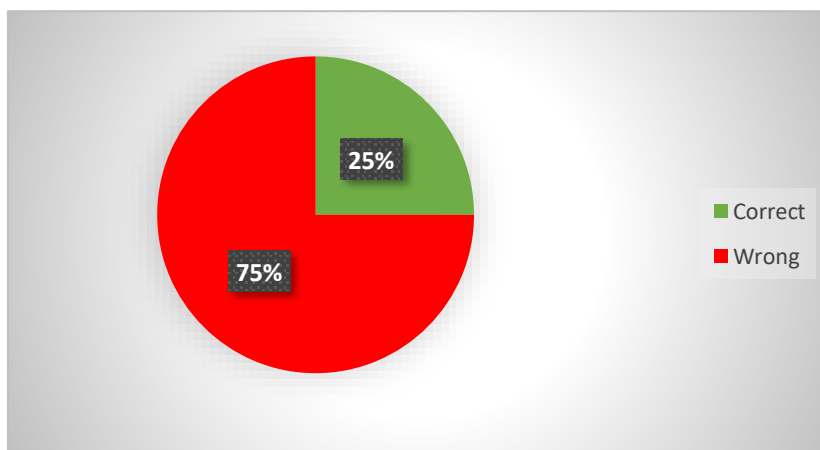


Figure 5: The Broca Aphasic Patient’s Average Percentage in Comprehending Passive (OVS) Sentences.

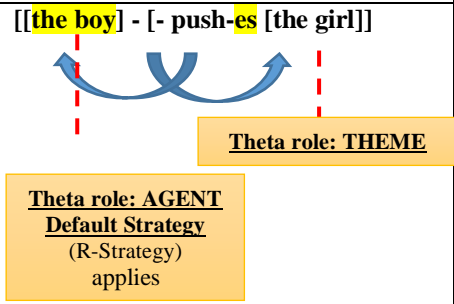
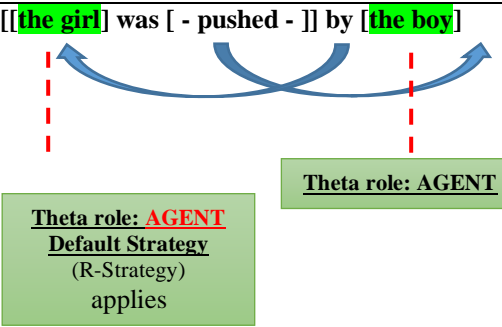
As shown in Table 2, the Broca’s aphasic patient comprehends well for the active sentences compared to passive sentences. The patient is considered as a good comprehender of active sentences when the patient obtained an average percentage of 91 percent and as a bad comprehender of passive sentences when the patient obtained an average percentage of 25 percent only.

The pie charts in Figure 4 and Figure 5 show the trends of correct and wrong answers obtained by the Broca’s aphasic patient in the study. Overall, it can be clearly seen that the patient

obtained more correct answers for active sentences compared to passive sentences for the first and second attempts of the SPMT.

4.2 The use of default strategy during the sentence comprehension

Table 3: The Broca Aphasic Patient’s Use of Default Strategy During Sentence Comprehension

	SVO – Active Sentences	OVS – Passive Sentences
	<i>the boy pushes the girl</i>	<i>the girl was pushed by the boy</i>
D-Structure	[-es[[the boy] push [the girl]]	[-ed[[the boy] push [the girl]]]
S-Structure	<p>[[the boy] - [- push-es [the girl]]</p>  <p>Theta role: THEME</p> <p>Theta role: AGENT <u>Default Strategy</u> (R-Strategy) applies</p>	<p>[[the girl] was [- pushed -]] by [the boy]</p>  <p>Theta role: AGENT</p> <p>Theta role: AGENT <u>Default Strategy</u> (R-Strategy) applies</p>

The theme role is assigned syntactically by the verb, while the agent role is assigned by the patient in this study to the non-thematic position of the subject through the default strategy, R-Strategy. So, whenever the displaced constituent or the trace (t) occupies the subject position and is an agent, the default strategy will suffice and compensate the comprehension deficit. This employment of this strategy leads the patient to perform well in SVO, active sentences.

The active sentence has two theta roles/NPs, namely an agent [*the boy*] and a theme [*the girl*]. When the passive sentence is formed, [*the boy*] merges within the Verb Phrase (VP) by means of the Prepositional Phrase (PP) headed by the preposition “by”. The subject position of the sentence is blank (trace) and therefore [*the girl*] moves and fills it. The verb assigns the theta role to [*the girl*] by means of the trace. This sentence processing usually happens in normal representation. However, during the sentence comprehension of a Broca’s aphasic patient, the trace is deleted, or it is not visible for theta-assignment, and [*the girl*], which is out of the VP cannot receive its theta role. Therefore, the default strategy, R-Strategy applies and assigns a theta role, namely agent in which the patient assigned the theta role, agent to the first NP seen in the sentence. Based on Table 3, the Broca aphasic patient’s comprehension of passive sentences has two agents, which is not possible in natural languages. O’Grady (2005) in the theta theory explained that a thematic role cannot be assigned to more than one argument within the same clause. Therefore, the Broca aphasic patient must decide which NP is the real agent and the only way the patient can do this, is by guessing.

5. Conclusion

Grodzinsky’s (1990) TDH involves two steps, the trace deletion from surface structure and the application of a linear non-linguistic strategy, the default strategy (R-Strategy). Broca’s aphasic patient in this study is considered as a good comprehender of SVO sentence structure even

though transformational movement and the deletion of traces exist in sentence structures. All these syntactic constructions of SVO sentence structures have their traces in common and their traces take up the subject position in the sentence structure. In order to explain correct theta assignment in these cases in which traces are deleted, the default strategy, R-Strategy as postulated by Grodzinsky's (1990) TDH was applied by the patient. Given the traces are deleted in Broca's aphasic patient's representation of a sentence, NPs would not receive a theta role. This fact would violate Chomsky's (1981) Theta Criterion principle and hence, default strategy is used as non-linguistic strategy to compensate (Friedman and Gvion, 2012; Teomiro Garcia, 2005). The patient assigns a theta role to NPs that are not in non-thematic positions in a linear way, that is, the patient assigns the role of agent to the first NP of a sentence. This strategy has been very useful for the patient to interpret and comprehend sentences, since it compensates the interrupted process of indirectly assigning theta-roles resulting from the deletion of traces.

The main findings of this study are that they provide a way to investigate the strategy used by Broca's aphasic patient when they fail to completely correspond to or process a sentence. One such strategy is known as a default strategy, R-strategy or the "Agent-first strategy, according to which when Broca aphasic patients fail to assign a thematic role to a moved element, for example in passive sentences, they assign the agent role to the first NP in the sentence (Friedmann and Gvion, 2012; Teomiro Garcia, 2005; Grodzinsky, 1990). This can be evident clearly when the Broca aphasic patient in this study guessed most of the passive sentences, which has eventually led to a bad performance overall.

Another implication of the findings is the Broca aphasic patient's guessing pattern shown during the SPMT. During the active sentence comprehension, the verb assigns the theme role to the object, and the default strategy, R-Strategy assigns the agent to the first NP, the subject is indeed the agent, and hence the patient points to the correct picture. However, when encountered with passive sentences, verb assigns the embedded subject the agent role but the default strategy, R-Strategy also assigns an agent role to the first NP. In this case, the patient is forced to guess between the two agents and decide which NP is the real agent.

To sum up, the results of the study reveal that the Broca's aphasic patient in this study has been using the default strategy, R-Strategy during their active and passive sentences comprehension process and due to the usage of the strategy, the patient is considered as a good comprehender of active sentences and a bad comprehender of passive sentences. Overall, the findings of this study support the account of Grodzinsky's (1995) TBA that consists of two main claims: Grodzinsky's (1990) TDH and R-Strategy.

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