Reviewing Production and Comprehension of Wh-questions in German Broca’s Aphasia

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Abstract

The studies on Broca’s aphasia sometimes produce contradictory results and this led to an ongoing debate on ‘contradictory results in aphasic studies’. Initially Broca’s aphasia was thought to be a speech production problem, but later on studies proved that they have comprehension problems (Caramazza, A., & Zurif, E. B., 1976) however there are studies (Goodglass, H., & Kaplan, E., 1983) which show that Aphasic patients can comprehend sentences in presented in comprehension tasks. However, there are studies that associate broca’s aphasics with both production and comprehension deficits. Still, others claim that they are not associated with single pattern of comprehension problem (Gordzinsky 1986, 1990) as well. They claim that they have no problem in understanding canonical sentences (active voice) but they perform at chance level while comprehending non-canonical sentences (Gordzinsky et al. 1999). Berndt, R. S., & Caramazza, A. (1999, 2001) criticizes Gordzinsk (1999) for the biasness by selecting specific sample that support their claims: “How ‘Regular’ is the Sentence Comprehension in Broca’s Aphasia? It Depends on How You Select the Patient” While the old connectionist model associates the production deficit to Broca’s Aphasia and the comprehension deficit to Wernicke’s Aphasia. Gordzinsky (2000) suggests that all these inconsistencies must be taken into account. The present research aims to examine the inconsistencies by presenting an overview of Trace deletion hypothesis and an analytical review on Eva Neuhaus, Martina Penke (2008) findings. They reported their

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observations and also many other findings that are not inconsistent with the Trace deletion hypothesis and trace based account (Hickok and Avrutin (1995, 1996).

Keywords: Broca’s Aphasia, Trace deletion hypothesis, comprehension, production

Introduction

Trace Deletion hypothesis

Trace deletion hypothesis is presented by Gordzinsky. Trace deletion hypothesis is based on the trace theory (theory about traces left by movement) this theory assumes that if an x-element is moved during the derivation process it leaves a trace behind the original position.

a. [which man] i did Mary like ti
b. *[which man] i did Mary spread the rumor that she liked ti

e.g. in the active sentence (a) antecedent which man has moved from its original position leaving a trace ti behind.

A trace is a phonetically silent but semantically active category. It plays several functions. Theta roles are transmitted via the link between the trace and its antecedent. A theme role is assigned to the entity undergoing some action. In the above sentence (a) verb like assigns the theme role to which man. Traces help to comprehend the structure with movement. There is a relation between traces and their antecedents because they share the mutual index. The sentence (b) is ungrammatical because the exceeding distance between the trace and its antecedent. Traces play an important role in determining the grammaticality of sentences. Gordzinsky discusses how this relationship between traces and their antecedents in movement operations influence the patient comprehension and production skills. Thus movement operations are involved in the comprehension deficit in Broca’s aphasia. They are unable to process the structures with movements. The study of this disruption can be helpful
in understanding the causes of Broca’s aphasic’s comprehension deficits. The basic observations Gordzinsky reported about agrammatic comprehension are as follows:

Structures derived by movement were hard to comprehend by the patients as compared to the structures without movements. On the basis of these findings Gordzinsky suggested a partition between these two types of structures i.e. structures with movement and structures without movement the patients showed normal comprehension on tasks requiring thematic role assignment e.g. agent, theme, goal etc. According to Gordzinsky all traces of movement are deleted in agrammatic Broca’s aphasia. So far this claim has been tested by many researchers via grammaticality judgment, sentence interpretation and online processing in agrammatism. All these empirical evidences support this claim and suggest that the patients suffer a disruption to only part of their syntax.

Moved constituents lack theta role for aphasics because of the deletion of the trace. It was suggested that moved NPs are assigned a role by default strategy. It assigns the agent role to traceless initial NPs. The interaction of this strategy for certain structures but it leads to confusion for sentences that are performed at chance level e.g. in case of the following active and passive sentences.

VP-internal subject hypothesis suggest that the movement of the subject from internal VP position of subject outside VP. According to Koopman & sportiche (1988) subjects are base generated inside VP and are forced to move up the tree. On account of the above hypothesis Gordzinsky argues that if this hypothesis is true, it may suggest that even actives can receive theta role directly. Traces play central role for theta transmission if traces are deleted then the subject of active sentence will have no theta role. The aphasics have no problems in active sentences comprehension. In response of this issue Gordzinsky proposes the default strategy and explains why the aphasis patients perform normal for active sentence (a). e.g. in sentence
An active sentence a subject The boy moves from the moves from the VP- internal position and leaves a trace behind denoted by ti (trace). The trace assigns the <agent> theta role to the boy. In Broca’s Aphasics the trace is deleted and hence the initial NP doesn’t receive the theta role. Instead the <Agent> role is assigned via the default strategy. Which leads to correct performance and normal performance is observed.

Aphasics show problems in comprehending the sentences with moved constituents. This is because moved constituents cannot receive theta role due to the deletion of traces. It is assumed that the moved NPs receive a theta role by default strategy. But still there is confusion for passive sentences that are performed at chance level e.g. in a passive sentence (b) agrammatic assigns the agent role to the girl because no syntactic movement in this part of sentence. On the other hand subject of the passive the boy is derived in two steps. Theta role is assigned via the links between these positions. According to Grodzinsky both of these traces are deleted in agrammatic Broca’s Aphasia which means that the subject of the passive sentence doesn’t receive theta role syntactically. Hence the default strategy assigns <agent> role to the NP the boy. Consequently the resulting thematic representation contains two agent roles. One in the by phrase and one in the subject phrase. That’s why chance level performance is expected for passive sentence because leads to guessing.

Normal assignment

<table>
<thead>
<tr>
<th>Agent</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>[The boy]</td>
<td>[VP ti pushed [the girl]]</td>
</tr>
</tbody>
</table>

Above chance

Agrammatic assignment

Normal assignment

<table>
<thead>
<tr>
<th>Theme</th>
<th>Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>[The boy]</td>
<td>was [VP t'i pushed ti] by [the girl]</td>
</tr>
</tbody>
</table>

Chance
Agrammatic assignment
Hence, the broca’s aphasic patients perform badly for non-canonical sentences while they perform above the chance level for canonical sentences.

Current syntactic deficit accounts and their prediction for wh-questions in German agrammatism
Trace deletion hypothesis postulates that traces of moved NPs are deleted from syntactic representations and a default theta role is assigned to those NPs that do not receive a theta role syntactically. For example in *wh-subject phrases* (1) the object (den Mann) receives the theta role directly by the verb (bürstet). In (2) den mann receives the theta role directly by the verb bürstet. While theta role of the moved *wh-subject phrase* (1, 2) *wer* (who) and *welche Fraui* (which women) is not directly assigned by the verb instead the default strategy assigns the default theta role \(<agent>\) to both *wer* and *welche Fraui*. Theta role is assigned to the subject phrase through the chain that connects its base position to its derived position after the movement. According to Gordzinsky in agrammatism this moved wh-subject phrase cannot receive the agent theta role because of the disrupted chain. The reason is that the trace left behind is deleted after the wh-subject movement from base to the derived position. The default strategy assigns the theta role to the initial wh-subject phrase. On account of this reason that the moved wh-subject phrase receives the same agent theta role by the default strategy that it would have otherwise received through the syntactic chain, the comprehension of such questions should not be impaired.
wh-subject phrases

(1) Who is brushing the man?
Wer bürstet den Mann?
Agent (default) agent

(2) Which woman is brushing the man?
Welche Frau bürstet den Mann?
(default) agent

derived base

wh-object phrase

(3) Who is the man brushing?
Wer bürstet den Mann?
Agent (default) agent

(4) Which man is the woman brushing?
Welchen Mann bürstet die Frau?
Agent (default) agent

derived base

wh-object phrases in examples (3) and (4) the theta role of the moved wh-object wen (who) and welchen Mann (which man) cannot be assigned due to chain disruption and therefore the default strategy assigns the default agent role to the initial wh-object phrase. Consequently the resultant thematic representation contains two agent theta roles, one that is assigned by the default strategy and the second theta role is assigned by the verb directly. On account of the operations mentioned above Trace deletion theory and default strategy predicts that as the agrammatic representation contains two agent theta roles to choose between, the comprehension of wh-object questions will drop to chance level.

VP-internal structure hypothesis postulates that subject NPs are base generated inside VP. In order to satisfy their features they move to specify TP and leave a trace inside VP. Eva Neuhaus and Martina Penke (2008) criticised the Gordzinsky’s and stated that merging the VP-internal structure hypothesis with Gordzinskys trace deletion hypothesis will lead to the following prediction: in wh-object questions both the object and subject phrases will not
receive a thematic role directly by the verb because both phrases are moved out of VP and their traces are deleted. Hence initial NP will receive a default agent theta role via default strategy. According to Eva Neuhaus and Martina Penke (2008) due to the above mentioned operations the agrammatic subjects will interpret the wh-object questions as wh-subject questions and their performance level would be expected to drop to 0%. But the agrammatic subjects showed a chance level performance with this type of subjects. In the light of above arguments Trace deletion hypothesis suggest that the comprehension of wh-object questions would be at chance level in agrammatic aphasics. In order to reinforce their argument Eva Neuhaus and Martina Penke (2008) reported Hickok and Avrutin (1995, 1996) findings who observed that agrammatic subjects showed chance level performance only for which N object questions but not for who object questions. They tested agrammatic comprehension on following four types of questions.

a. Whoi did the horse chase ti?  
   above chance
b. Whoi ti chased the giraffe?  
   above chance
c. [Which giraffe]i did the horse chase ti?  
   chance
d. [Which horse]i ti chased the giraffe?  
   above chance

The above results are consistent with the trace deletion hypothesis except the ‘who object question’, subject performed above chance level.

**Experiment Design**

EVA Neuhaus & Martina Penke (2008) used pictures in their study to test the wh-comprehension questions. The pictures show semantically reversible action performed by two of the three persons. The action is always done from person A to person C (left to right). Person A and C are of the same sex. For instance in the given picture a man is brushing a women who in turn is brushing a man. Visual and auditory both types of stimuli were used to present the wh-questions to the subjects.Wer bu¨rstet den Mann (‘who is brushing the man?’).
To answer the questions, subjects had to point to the corresponding person in the picture (in this case B).

Wer bürstet den Mann?  
(W‘Who is brushing the man?’)

For Four different types of wh-questions 60 pictures and 60 wh questions were used. They tested:

- 10 which N subject questions e.g Welcher Mann bürstet die Frau? ‘which man is brushing the woman?’
- 20 who subject questions e.g. Wer bürstet den Mann? ‘who is brushing the man?’, Wer bürstet die Frau? ‘Who is brushing the woman? 
- 20 wh-object questions e.g. Wen bürstet der Mann? ‘Who is the man brushing? Wen bürstet die Frau? ‘Who is the woman brushing?’
- 10 which N object questions e.g. Welchen Mann bürstet die Frau? ‘Which man is the woman brushing?’

The subjects has three choices A,B,C. on listening the auditory question subjects have to simply reply to the question by pointing to the picture to refer to the person performing the action.
EVA Neuhaus and Martina Penke Findings

Results show the correctness score for comprehension of wh-questions. 9 German aphasic subjects performed in the picture pointing task.

[Bar chart showing correctness scores for who object conditions and which N conditions]

*Fig. 2. Correctness scores for the who object conditions (pg. 162)*

*Fig. 3. Correctness scores for the which N conditions (pg. 162)*

Light bars show the correctness score for wh-subject questions and the light bars show the scores for wh-object question. As the subjects were given three choices for each question a chance level was set for 33%. The first two subjects showed a good performance for both
who and which N subject conditions. E.s showed above the chance level performance in both who subject and who object questions 95 and 75% respectively but showed and different pattern for which N phrase. E.S only performed badly for which N object questions while performed good at which N subject questions. GB, and M.B displayed above the chance level performance for both who-subject, who object question, & for which N subject question but both of them performed at chance level for which N object questions.

Subjects W.R, W.W, P.B, R.M showed different performance pattern, none of them could score above the chance level. According to EVA Neuhaus & Martina Penke (2008) both the Trace delition hypothesis and Trace base account are not consistent with this kind of patterns. None of them accounts for these varying patterns.

But looking closely at this graph and data presented by EVA Neuhaus & Martina Penke (2008) we see that the first two subjects I.k and M.J performed good at both wh- subject questions while bad at wh-object questions. That is consistent with the presuppositions of Trace deletion hypothesis. Es showed the same behavior by performing well at which N subject while bad at which object questions. E.S showed only different pattern for who subject and object phrases by performing above chance level. The performance of M.B and G.B is good at which N subject questions while at chance level for which N object questions. In contrast they showed high level performance above the chance level for both who subject and who object questions.

EVA Neuhaus & Martina Penke (2008) argue that both Trace Deletion hypothesis and Trace based account are not inconsistent with the behavioral patterns they observed in their individual subjects (Agrammatic broca’s aphasics). Therefore, they suggested the Implicational scaling analysis for the four different types of wh-questions. The figure above shows the implicational scaling that EVA Neuhaus & Martina Penke (2008) used to analyze
their data. They reported the two subjects I.K and E.S showing the parallel behavior to implicational scale. EVA Neuhaus & Martina Penke (2008) mentioned that I.K subject showed a chance level performance for ‘which N object’ and ‘who object questions’ while performed above chance level for ‘which N subject, considering the above chance score implicational scaling predicts the above chance level performance for who subject also, and the subject performed accordance with the implicational scale prediction. In order to reconsolidate their claim they presented the example of another subject showing the parallel behaviour to implicational scale. E.S behavioral pattern for the four different type wh-question is shown in the figure below confirming the aforementioned argument.

Implicational Scaling Analysis

Fig.4 shows the implicational scale and I.K and S.E. behavioral pattern in four different type wh-questions.

In order to highlight the above mentioned issue they presented the data from Thompson et al. (1990) who reported that he observed different behavioral patterns in all of his four broca’s aphasic subjects. One showed the trace based account pattern, second disapproved it and
showed the reverse pattern, third confirmed the trace deletion hypothesis while fourth score was above chance level in all conditions.

In order to consolidate their finding Eva Neuhaus & Martina Penk (2008) presented the data from Salis and Edwards (2005) experiment. Who tested the five English speaking agrammatic Broca’s aphasics for comprehension of different types of wh-questions. They found the similar pattern of performance, declining gradually from wh/what subject (83%) to which N subject question (67%) to who/what object (65%) to which N object 38%. Fig is clearly showing this declining pattern. In order to support of the additive effect they presented, Eva Neuhaus & Martina Penk (2008) added Avrutin (2000)

**Discussion**

Eva Neuhaus and Martina Penke (2008) reported their observations and also many other findings that are not inconsistent with the Trace deletion hypothesis and trace based account e.g. Hickok and Avrutin (1995, 1996), Thompson et al. (1999), Salis and Edwards (2005) etc.

If we suppose a language without traces and or think that there are no traces in language. What sort of performances a traceless language user will display. 1st. It would create problems in the movement of derived constituents and all of the other constituents will be frozen at their own place. 2nd it would create problems in detecting the ungrammaticality, as the traces determine the grammaticality. And in sentences it would create problems in linking
antecedents to the positions they left empty after their movement. Considering the above points if we believe that traces play a role in transformation, the next step is to distribution and deletion of traces.

According to Grodzinsky the most important notable point is that some studies produce two types of contradictory results: the studies that are failed to replicate the previous results and those that reported observations against Trace deletion hypothesis but accept the basic principles e.g. Hickok and Avrutin (1995, 1996). Both of these inconsistencies must be taken into account. As an unstable syndrome or non-existence syndrome is wrong object of enquiry, similarly it is wrong to follow a false hypothesis:

i. The difference in the behavioural pattern of subjects violating from the trace deletion hypothesis and showing the unpredicted results etc. is explainable.

ii. The clinical categorizations have been under discussion for many years. Wrong categorisation of patients can lead to wrong observations.

iii. The patient selection can be the cause of inconsistency. In many experiments patients that were not broca’s aphasics were included in the experimental group.

iv. In some experiments there were problems with experimental designs and procedure.

v. In some experiments the results have been misanalysed or misinterpreted.

vi. There have been a lot of experiments in which many neurologically and brain damaged patients have been tested in different laboratories and at different times.

vii. Many experiments have been done in different countries and with different languages and for a variety of sentence types.

viii. A variety of tasks have been used for experiments e.g. some studies come from grammaticality judgement tasks, some from real time processing and still there from comprehension in several languages.

The most important notable points in these experiments are the intersubject variations. Grodzinsky et al. (1999) had conducted a survey of comprehension scores of Broca’s aphasics in two (contrasts that are related TDH): actives versus passives and subject-gap versus object-gap relative clauses. For both sentence types, there are multiple studies. A
significant performance difference was expected for active and passive sentences. It was predicted that the performance on active sentences would be approximately 100%. While a chance level performance was expected for passive sentences. The reason behind this is that the passive sentences are the expression of a chance behaviour that involves a guessing behaviour. According to Gordzinsky this guessing behaviour can be compared to a series of coins tosses and therefore must be distributed binomially with a median of about 50% correct. On the account of this chance behaviour, active and passive sentences were predicted to have a different performance level significantly. Gordzinsky reported that analysis of the actual data followed the same behavioural patterns of performance as it was predicted. Both differ significantly with 100%, while the passive distributed binomially 55% respectively. Gordzinsky (1999) reported that the Analysis of the subject, object relative clauses also produced similar results.

References


