Agrammatism and the Lexicon-Syntax Interface: Dutch Aphasics’ Performance on Saturated Experiencer Verbs*

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This work argues that impairment in certain operations at the interface between the lexicon and the syntax are responsible of agrammatic comprehension of semantically reversible passive sentences. More concretely, and following Reinhart’s (2002) Theta System, I put forward the hypothesis that reduction operations delete more material in agrammatic than in non-agrammatic derivations. I report on the results of an experiment, and provide empirical data that support the hypothesis defended here versus Grodzinsky’s (1995) Trace Based Account, which states that movement is hampered in agrammatic comprehension.

1 INTRODUCTION

About one third of the people that suffer from agrammatism (Berndt, Mitchum and Haendiges 1996) have problems with the interpretation of semantically reversible passive (SRP) sentences such as (1a). Their performance on true/false judgment tasks with such sentences is at chance: Mary is sometimes understood as patient, and other times as the agent of the event. On the other hand, the interpretation of the active counterpart (1b) presents no apparent problems.

(1) (a) Mary[patient/theme] is kissed by John[agent]
    (b) John[agent] kisses Mary[patient/theme]

One of the most influential accounts of this pattern of comprehension is Grodzinsky’s (1995) Trace Based Account (TBA), which states that movement, one of the core operations of syntax, is problematic in agrammatism because the traces of nominals in theta marked positions are deleted (the Trace Deletion Hypothesis). Hence, the moved DP cannot form a chain with its trace and receives no theta role from the verb. A non-linguistic strategy (the R-Strategy) assigns the moved nominal a theta-role in accordance with Jackendoff’s (1972) Thematic Hierarchy by virtue of its linear position.

However, the TBA faces both empirical and theoretical problems. Empirically, a chance performance is predicted by the TBA with unaccusative verbs since they involve A-movement from object position to subject position. However, Piñango (2000) shows that agrammatics’ performance with these verbs is above chance. Moreover, Beretta and Munn (1998) demonstrate that there are no double agents in agrammatics’ linguistic representations, contrary to the TBA’s claim. Finally, Avrutin (2000) gives evidence that supports the claim that other factors, such as resorting to the discourse storage, play a central role in agrammatic comprehension.

From a theoretical perspective, the TBA needs to be reformulated to fit within the assumptions of the Minimalist Program (Chomsky 1995, 2001). First, the TBA is based on a

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representational model of the grammar. It operates at the S-Structure, which no longer exists as a syntactic level in the derivational model of Chomsky’s (2001). The Non-Inclusiveness Condition forces the notion of trace to disappear from linguistic theory and the movement is understood as copying elements. If movement is just another instance of Merge, I(nternal)-merge as Chomsky (2006) claims, there is no reason, in principle, to expect movement (I-merge) to be impaired while E(xternal)-merge remains intact.

Due to these shortcomings, this paper presents an alternative hypothesis that accounts for agrammatic comprehension of sentence (1a)\(^1\). This hypothesis is integrated in the Minimalist Program, thus in a derivational model that respects the Non-Inclusiveness Condition. I will provide empirical evidence that falsifies the TBA’s claim that agrammatic comprehension is due to impairment in movement itself and deletion of traces, and supports the claim that impairment is at the lexicon-syntax interface.

2 THE LEXICON-SYNTAX INTERFACE: REINHART’S THETA SYSTEM

The Theta System (TS) is, following Reinhart (2002), the system that enables the interface between the System of Concepts and the Computational System (CS). It consists of (at least):

- **Lexical entries**, which are coded concepts. Very little of the concepts’ semantic information is visible to the syntax, and this information is codified by formal features defining the thematic relations of verb and its arguments. The lexicon has traditionally been understood as the collection of these lexical entries.

- **Arity operations** on lexical entries, which may generate new entries, or just new options of realization.

- **Marking procedures**, which prepare a verb entry for syntactic derivation.

The semantic information of the concepts visible to the CS is codified by two features (they can be either positive or negative):

- The /c/ feature is associated with an argument that is perceived as sufficient condition for the action described by the verb.

- The feature /m/ is associated with some sort of mental state of the participant though it does not determine the causal status of the argument (i.e. whether or not it is a sufficient condition).

**These features combine in order to** form eight feature clusters, given in (2), which roughly correspond with the traditional theta roles. A cluster can be positive if both features are positive, as in (2a,e,g) or negative if the two features are negative as in (2c,f,h). When one feature is positive and the other negative, the cluster is said to be mixed, as (2b,d).

(2) Feature composition of the (traditional) theta-roles:

- a) \([+c+m]\) Agent
- b) \([+c-m]\) Instrument
- c) \([-c-m]\) Theme/patient
- d) \([-c+m]\) experiencer
- e) \([+c]\) Cause
- f) \([-c]\) Goal/benefactor
- g) \([+m]\) Sentient
- h) \([-m]\) Subject matter

The clusters are marked in the TS so that they can be processed by the CS. The marking procedures are in (3), whereby a negative cluster receives an index 2, as shown in (3a), and a positive cluster is marked with an index 1, as shown in (3b). The mixed clusters remain unmarked. The lexicon marking procedures also specify the conditions under which the verbs may have an ACC feature, as shown in (3c). The indexes 1 and 2 define how the arguments are merged in the syntax. The merging instructions in (4) are the way the CS “interprets” the

\(^1\) Other syntactic configurations are problematic too, such as object relatives or object clefts (Grodzinsky 1995, among others). However, an explanation of agrammatic comprehension of all these constructions is beyond the scope of this paper due to space limitations.
merging indexes: namely, a cluster with an index 2 merges within the vP and a cluster with an index 1 merges out of the vP. Mixed clusters may merge either within or out of the vP by (4a), depending on the syntactic configuration.

(3) **Lexicon marking**: given an n-place verb entry, n>1,
   (a) mark a [−] cluster with index 2
   (b) mark a [+] cluster with index 1
   (c) if the entry includes both a [+c] cluster and a fully specified [/α/-c], mark the verb with the ACC feature.

(4) **CS merging instructions**:
   (a) when nothing rules this out, merge externally (out of the vP),
   (b) an argument realizing a cluster marked 2 merges internally (within the vP),
       an argument with a cluster marked 1 merges externally.

Finally, there is a set of operations on the lexical entries that either reduce or expand their arity. Only two operations are crucial for us: saturation and expletivization.

Saturation is responsible for passivization and it reduces the external argument by existential closure in the syntax. The reduced argument is not realized syntactically and nor is the ACC feature of the verb. However, since the saturation has taken place in the syntax and not in the lexicon, the reduced argument is still present in the semantic interpretation as in (5c).

(5) **Saturation**:
   (a) **Basic entry**: kissacc ([+c+m]1[-c-m]2) “John kisses Mary”
   (b) **Saturation**: S(kiss) ([−c-m]2) “Mary is kissed Mary (by John)”
   (c) **Interpretation**: \( \lambda x [\text{kiss}(\text{Mary},x)] \rightarrow \text{saturation} \rightarrow \exists x [\text{kiss}(\text{Mary},x)] \)

Expletivization provides unaccusative entries of causative verbs. The [+c] role of the verb is reduced or deleted in the lexicon as well as the ACC feature. This role is not realized syntactically nor is it present in the semantic interpretation as in (6c).

(6) **Expletivization**:
   (a) **Basic entry**: openacc ([+c],[−c-m]2) “John opened the door”
   (b) **Expletivization**: R(open) ([−c-m]2) “The door opened the door”
   (c) **Interpretation**: \( \lambda x [\text{open (door},x)] \rightarrow \text{expletivization} \rightarrow \text{open (door)} \)

3 **The Proposal: Over-Deletion**

My proposal, given in (7), claims that the agrammatistics’ TBA-like pattern of comprehension of SRP sentences like (1a), results from the fact that reduction operations on the verb lexical entries (expletivization and saturation) delete not only the theta and the accusative features (which is the way a non-aphasic Theta System works) but, crucially, also the merging indices 1 and 2. The latter operation is specific to agrammatism, i.e. it is not found in the grammar of non-agrammatistics.

(7) **The Over-Deletion Hypothesis (ODH)**: The agrammatistics’ TBA-like pattern of comprehension of SRP sentences like (1a) is due to the fact that the reduction operations (expletivization and saturation) on the

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\(^2\) Note that the expression “externally/internally merge” refers here to the structural position where the argument is merged to respect the vP. It must not be confused with the terms I(internal)/E(external)-merge mentioned in section 1.
lexical entries of the verbs delete (a) theta features, (b) the ACC feature and, crucially, (c) the merging indices.

3.1 Passive verbs with (saturated) [+c+m] subjects

When saturation applies in agrammatic sentences, as in (8c), the merging index 2 is deleted along with the [+c+m] role and the accusative feature. The remaining [-c-m] argument merges externally by (4a) and the structure is that of a unergative verb with a theme [-c-m] argument in subject position. There exist verbs that have such an argumental structure, namely, the “theme unergative verbs” in (9). These verbs are incompatible with a role that contains any causal specification (see Reinhart 2002:236). Since the index 2 has been deleted, when the agrammatic tries to process a sentence with a phonological form like (8c), the structure is identified as that of a theme unergative verb in (9a). Although the index 2 has disappeared, and the structure is misidentified, the agrammatic still “knows” that the verb has undergone saturation and that there is a [+c+m] role implicit in the semantic representation as in (8d). Since theme unergative verbs are incompatible with any [+c] or [+c+m] argument, the derivation crashes at LF.

(8) Passive verbs:
(a) Basic entry: kissacc ([+c+m]_1[-c-m]_2) “John kisses Mary”
(b) Saturation (1): S(kiss)([-c-m]_2) “Mary is kissed Mary (by John)”
(c) Saturation (2): S(kiss)([-c-m] ) “Mary is kissed (by John)”
(d) Interpretation: λx [ kiss (Mary,x)] → saturation → ∃x [ kiss (Mary,x)]

(9) Theme unergative verbs:
(a) Lexical entry: glows([-c-m]) “The diamond glows”
(b) Interpretation: λx[glow(x)] → glow(diamond)

3.2 Unaccusative verbs

Unaccusative verbs are better understood by agrammatic sentences (namely, above chance as Piñango 2000, among others, has shown). When expletivization applies, the merging index 2 is deleted besides the [+c] role and the accusative feature. Since the remaining [-c-m] argument has no index, it merges externally by (4a). This structure in (10c) is misidentified with that of a theme unergative verb in (9a). However, the derivation does not crash at LF since the [+c] role has been saturated in the lexicon and so, it is not present in the semantic interpretation as in (10d). The performance is above chance because the derivation does not crash at LF. However, it is not perfect (or completely normal) because these verbs are understood as if they were theme unergative and not unaccusative verbs.

(10) Unaccusative verbs:
(a) Basic entry: openacc ([+c]_1[-c-m]_2) “John opened the door”
(b) Expletiv. (1): R(open)([-c-m]_2) “The door opened the door”
(c) Expletiv. (2): R(open)([-c-m] ) “The door opened”
(d) Interpretation: λx [ open (door,x)] → expletivization → open (door)

3.3 Passive verbs with (saturated) [-c+m] subjects

The ODH in (7) makes the correct predictions for passives, actives (in this case no operation applies and the derivation proceeds as usual) and unaccusatives. The TBA makes the correct predictions for passives and actives but not for unaccusatives. Let us look at another kind of
verbs that may provide us empirical evidence supporting one of the other hypotheses: experiencer verbs. They are thought by Reinhart (2002) to have the lexical entry in (12a) below. The optional role \([-m]\) is not crucial for our purposes and will be ignored.

Following the TBA, when these verbs are passivized as in (11a), \textit{Lucie} has to move from object position to subject position. Since its trace is deleted, \textit{Lucie} cannot form a chain with a theta position and is not visible at LF. The R-Strategy applies and \textit{Lucie} is assigned an agent role. Since there are two agents in the representation, the agrammatic is forced to guess and chance performance is predicted.

My hypothesis (7) predicts that the performance with this kind of verbs is above chance. Let us see why. The basic entry of an experiencer verb like \textit{worry} is in (12a). Saturation in agrammatics applies, as in (12c) and the merging index 2 is deleted besides the [+c] role and the accusative feature. The remaining [-c+m] argument will merge externally by (4a) and the structure will be that of an unergative verb. However, it is not the structure of a theme unergative verb because the argument in subject position bears a [-c+m] experiencer and not a [-c-m] theme role. Then, they are not incompatible with the saturated [+c] role still present in the semantic representation (12d). The performance is above chance because there is no breakdown but they are understood as unergative verbs.

(11) **Experiencer verbs (TBA predictions):**

- **Normal representation:** \textit{Lucie}_{[patient]} is worried \textit{t}_i (by \textit{Max}_{[agent]})
- **Trace deletion:** \textit{Lucie}_{[no theta role]} is worried (by \textit{Max}_{[agent]})
- **R-Strategy:** \textit{Lucie}_{[agent]} is worried (by \textit{Max}_{[agent]})

(12) **Experiencer verbs (over-deletion predictions):**

- **basic entry:** \textit{worry}_{acc} ([+c][-c+m][[-m]_2] “Max worries \textit{Lucie}”
- **sat. (1):** \textit{S(worry)} ( [+[-c+m][[-m]_2]) “Lucie is worried \textit{Lucie} (by \textit{Max})”
- **sat. (2):** \textit{S(worry)} ( [-[-c+m][[-m]_2]) “Lucie is worried (by \textit{Max})”
- **Interpretation:** \lambda \textit{x}[\textit{worry (Lucie,x)}] \rightarrow \textit{saturation} \rightarrow \exists \textit{x}[\textit{worry (Mary,x)}]

4 **EMPIRICAL DATA**

4.1 Hypotheses

The experiment aims at comparing the predictions of the TBA and the ODH in (7). Table (1) summarizes the predictions of the two hypotheses with respect to several kinds of structures. More concretely, for passivized (saturated) experiencer verbs the TBA predicts a chance performance whereas my hypothesis in (12) predicts an above chance performance.

<table>
<thead>
<tr>
<th></th>
<th>TBA</th>
<th>ODH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaccusatives</td>
<td>Chance</td>
<td>Above chance</td>
</tr>
<tr>
<td>(active) agentive verbs</td>
<td>above chance</td>
<td>above chance</td>
</tr>
<tr>
<td>Saturated (passive) agentive verbs</td>
<td>Chance</td>
<td>Chance</td>
</tr>
<tr>
<td>Saturated experiencer verbs</td>
<td>chance</td>
<td>Above chance</td>
</tr>
</tbody>
</table>

*Table 1*

Predictions of TBA vs. ODH

3 The index [.] cannot be deleted by the operation \textit{saturation} because it applies in syntax (unlike \textit{expletivization}, which deletes the role altogether as well as the index it bears). Since this index is still present in the syntax, the experiencer role must merge internally (Siloni 2002).
4.2 Subjects

The subjects were divided in two groups:
- An experimental group composed of 6 patients (native speakers of Dutch) affected with aphasia and receiving treatment in the rehabilitation center De Hoogstraat in Utrecht (The Netherlands). Table (2) shows the demographic data and diagnosis.
- The control group consisted of 6 students of the Faculty of Arts at the University Utrecht. They were native speakers of Dutch.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Initials</th>
<th>Gender</th>
<th>Age</th>
<th>Lesion</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D.L.</td>
<td>Male</td>
<td>64</td>
<td>CVA left</td>
<td>Global</td>
</tr>
<tr>
<td>2</td>
<td>M.B.</td>
<td>Female</td>
<td>50</td>
<td>Intracerebral hematoma</td>
<td>Broca</td>
</tr>
<tr>
<td>3</td>
<td>D.H.</td>
<td>Male</td>
<td>47</td>
<td>CVA left</td>
<td>Mixed</td>
</tr>
<tr>
<td>4</td>
<td>D.F.</td>
<td>Male</td>
<td>35</td>
<td>CVA left</td>
<td>Wernicke</td>
</tr>
<tr>
<td>5</td>
<td>D.M.</td>
<td>Male</td>
<td>53</td>
<td>CVA left</td>
<td>Global</td>
</tr>
<tr>
<td>6</td>
<td>D.A.</td>
<td>Male</td>
<td>26</td>
<td>CVA left</td>
<td>Broca</td>
</tr>
</tbody>
</table>

Table 2
Experimental subjects

4.3 Materials and procedures

The task consisted of a true/false judgment of a sentence inserted in a context given by a short story, as in (13), and a B/W picture, as in Figure (1). There were such 16 items.

(13) Example of an item used in the experiment:
- (a) Story: ‘Marie heeft een drukke dag gehad. Het enige dat zij wil doen is naar bed gaan om wat te slapen. Jan is thuis en hijzit gitaar te spelen omdat hij morgen een concert moet geven. Marie vindt het heel lasting omdat ze hoofdpijn heeft.’
  (Translation: Marie has had a stressful day. The only thing she wants to do is go to bed. Jan has arrived at home and he starts playing guitar because he has to give a concert tomorrow. Marie finds the situation annoying because she has a headache.)
- (b) Sentence: ‘Marie wordt geërgeerd door Jan’
  Marie is annoyed by Jan

The sentences used in the experiment were divided into:
- 8 Target sentences: passive sentences such as (14) with a Dutch experiencer verb that has undergone saturation of its [+c] role. The by-phrase is explicitly present.
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(14) Jan_{[-c+m]} wordt verblijd door Marie_{[+c]}
     Jan is rejoiced by Marie

- **8 Control sentences:** 4 passive sentences like (15) with a Dutch agentive verb (which has undergone saturation of its [+c+m] role), and 4 active sentences like (16) with a Dutch agentive verb (no saturation applies, no passivization). These items are typically used in the experiments of Grodzinsky’s (1995). The *by*-phrase is explicitly present in the passive sentences.

(15) Marie_{[+c+m]} omarmt Jan_{[-c-m]}
     Marie embrace Jan

(16) Jan_{[-c-m]} wordt gezoend door Marie_{[+c+m]}
     Jan is kissed by Marie

There were three conditions in the experiment:

- **Two control conditions** that showed whether the subjects performed as the TBA predicts on passive versus active agentive verbs or not.
- **One experimental condition** aimed at contrasting the ODH vs. the TBA.

### 4.4 Results

4 subjects were used in the analysis of data since M.B. and D.M. had a performance opposite to the one predicted by the TBA with agentive passive vs. active sentences. The individual results are given in table (3). The means of the groups are in Table (4).

<table>
<thead>
<tr>
<th>Subject</th>
<th>Initials</th>
<th>Saturated experiencer</th>
<th>Saturated agentive</th>
<th>Agentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D.L.</td>
<td>0.88</td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>M.B.</td>
<td>0.63</td>
<td>0.75</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>D.H.</td>
<td>0.88</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>D.F.</td>
<td>0.75</td>
<td>0.25</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>D.M.</td>
<td>0.63</td>
<td>0.75</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>D.A.</td>
<td>0.88</td>
<td>0.75</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3**

Individual means

<table>
<thead>
<tr>
<th></th>
<th>experimental group</th>
<th>control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Saturated experiencer</td>
<td>0.8438</td>
<td>0.06250</td>
</tr>
<tr>
<td>Saturated agentive</td>
<td>0.5625</td>
<td>0.23936</td>
</tr>
<tr>
<td>Agentive</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 4**

Means of the groups

The mean of experimental group in saturated agentive sentences (0.5625) was at chance (df=3, p=0.638), i.e. the difference with 0.5 was not significant. The mean of the experimental group in saturated experiencer sentences (0.8438) was above chance (df=3, p=0.002) though below normal-like performance (df=3, p=0.015), as the hypothesis (11) predicts. This mean is different from the mean of this group in saturated agentive sentences (df=3, p=0.024).
5 CONCLUSIONS

To conclude, the empirical data in section 4 support the ODH in (7): if agrammatics had problems with traces in theta positions and movement, saturated experiencer sentences should trigger performance at chance. The experiment presented in this paper shows that agrammatics’ performance in these kinds of sentences is above chance though not normal-like, which is explained by (7) and unexpected by the TBA. Moreover, the ODH also predicts above-chance performance in unaccusative verbs (which is empirically correct, Piñango 2000), unlike the TBA. The empirical evidence provided in this paper supports the argument that agrammatic comprehension is not due to impairment in movement itself and trace deletion, as the TBA claims, but that the lexicon-syntax interface plays a central role in agrammatic comprehension.

REFERENCES


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