Negation in agrammatism: a cross-linguistic comparison

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Abstract

Negation is a concept that has hardly received attention in aphasia research. The present study describes the performance of agrammatic speakers of three different languages — English, Dutch and Norwegian — on a sentence comprehension and two sentence anagram tests. These languages have been chosen, because the structure of the negative sentence is different in terms of the internal structure of the negation phrase (NegP) and the position of this phrase in the syntactic tree.

No difference in comprehension of negative and affirmative sentences is found. The results on the sentence construction tests, however, vary per language. The English agrammatics are worse than the Dutch and Norwegian in constructing negative, but not in positive sentences. It is suggested that it is the internal structure of NegP that influences agrammatic performance on a sentence construction task. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Agrammatism; Aphasia; Cross-linguistic research; Negation; Neurolinguistics

1. Introduction

This study focuses on negation in agrammatic aphasia. A cross-linguistic comparison of comprehension and production of negative sentences will be made between the performances of English, Dutch and Norwegian agrammatic aphasics.

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Little has been written about negation in aphasia. A study done by Bebout [1] dealt with the differences of syntactic (*not*) versus morphological derived (*un-* ) negation in production and comprehension. The patient group consisted mainly (but not only) of nonfluent aphasics. These patients were better in producing sentences with a negative affix than sentences with a full negation (*not*). For comprehension, this difference was not found. The results of this study were reanalyzed by Taylor [2] with respect to Grodzinsky’s [3] theory on agrammatic production and comprehension and the competition model. Taylor argued that neither of these theories fully account for Bebout’s data, but that in combination they provide a uniform account.

Juncos-Rabadán demonstrated more or less the same as Bebout [1]. One of his studies [4] focused on the truth value of negation in fluent aphasia. The results show that fluent aphasics have problems with the logico-semantic processing of negation and that they prefer affirmatives with a negative morpheme (smoking is *un*healthy) to negative sentences (smoking is *not* healthy). In a second study [5], unfortunately only published in Spanish, Juncos-Rabadán demonstrated that Spanish speaking Wernicke patients have problems in understanding negative sentences that only contain the negation *no* (*el chico no empuja a la chica*, lit. *the boy not pushes the girl: the boy does not push the girl*). If the negation is also expressed by a negative polarity item, like *never*, *nothing* etc., words that are always accompanied by *no* in Spanish (*el chico no coge nada*: lit. *the boy not takes nothing: the boy takes nothing*), comprehension is significantly better. In fact, it is even better than comprehension of affirmative sentences.

The present study has been undertaken to explore whether English, Dutch and Norwegian agrammatic aphasics have problems with comprehension and/or production of negative sentences. The focus of this study is on the syntactic aspects of negation, for which Universal Grammar (UG) offers the theoretical framework.1

First, some influential ideas on the syntactic structure of negative sentences in English, Dutch and Norwegian will be presented. Then, relevant theories about agrammatic comprehension and production will be discussed, resulting in the hypotheses about comprehension and production of negative sentences. Subsequently, three experiments will be described. Finally, the results will be given and discussed.

### 1.1. Negation in syntactic structure

Negation is considered to be a functional category, consisting of a maximal projection (NegP), a specifier, a head (Neg) and a complement [cf. 6] (see Fig. 1).

Ouhalla [7] claims that the internal organization of NegP is language-dependent: in some languages the negation morpheme is the specifier of NegP, in other

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1 Our syntactic analysis of negative sentences is based on UG, as this theory discusses negation in relation to verb movement; a process that can be observed most clearly in English.
languages it is the head of NegP (Neg). The internal structure of NegP depends on grammatical constraints: if negation is related to verb-movement, it is the head of NegP, otherwise it is the specifier.\footnote{According to Kayne [8], specifiers are phrases. The present analysis does not correspond with that assumption, but an alternative for the structure of NegP is not given by Kayne.} If the head position of NegP is not filled with a lexical item, it is filled with an abstract morpheme. Furthermore, if the head is an affixal or abstract morpheme, verb-movement is allowed to/through it. The position of NegP in the syntactic tree is language-dependent too. The position and the internal structure of NegP differ in English, Dutch and Norwegian.

1.2. Negation in English

Consider the following sentences:

(1) John always reads the book.
(1a) *John not reads the book.
(1b) John does not read the book.

According to the Minimalist Program [6], lexical elements carry features that are associated with inflections, such as Tense and Agreement affixes, that need to be checked in the functional domain. This may be done either covertly or overtly depending on whether the feature is weak or strong. In the former case, checking is done after Spell-out and in the latter case, checking is done before Spell-out. In English, the verb does not move overtly to T and AgrS to check its features, but checking takes place after Spell-out. As a consequence, the verb does not take the second position of the sentence, as can be seen in (1). When not is inserted, the verb cannot move covertly to T and AgrS to check its features, because passing over Neg will violate the Head Movement Constraint (HMC). Sentence (1a) is derived by the ungrammatical cyclic covert movement of V to T and AgrS across Neg. This example shows that not is head of NegP. The verb cannot move to/through Neg, since not is non-affixal in nature. Sentence (1b) is derived by do-
insertion: V cannot move covertly to T and AgrS, because that would induce a violation of the HMC, leaving the I elements stranded. Therefore, do is inserted to express the tense and agreement inflections:

(1c) The boys do not read books.
(1d) John did not read the book.

Do is base-generated in T and moves to AgrS to check its features. The syntactic structure of sentence (1b) is presented in Fig. 2.

1.3. Negation in Dutch

Consider the following sentences:

(2a) Jan leest het boek.
John reads the book.

(2b) Jan leest het boek niet.
Lit. John reads the book not (John does not read the book).

Dutch is assumed to be an SOV language, with V-second in the matrix clause [9]. Sentence (2b) is derived by a cyclic movement of V to T and AgrS through Neg, undisturbed by the presence of NegP. Therefore, it is assumed that the specifier of NegP is filled with niet and that Neg is filled with an abstract morpheme, allowing head movement to/through it. Sentence (2b) is presented in Fig. 3.

Fig. 2. The syntactic tree of the sentence John does not read the book.
1.4. Negation in Norwegian

Consider the following sentences:

(3a) Jens leser boka.
John reads the book.

(3b) Jens leser, ikke t_j boka.
Lit. John reads not the book (John does not read the book).

Norwegian is an SVO language with V-second in the matrix clause. As can be seen in sentence (3b), the verb moves overtly out of the VP into the functional domain to check its features when the negation \textit{ikke} is inserted in the sentence. Therefore, it is assumed that \textit{ikke} is the specifier of NegP. Fig. 4 presents the syntactic structure of sentence (3b).

In sum, the internal structure and the position of NegP in the syntactic tree are language-dependent. In English, \textit{not} blocks covert movement of the verb. Therefore, \textit{not} is considered head of NegP. \textit{Do} is inserted in T to support the inflectional elements. NegP is located between TP and AgrOP. In Dutch, \textit{niet} does not interfere with verb raising and, therefore, is considered to be the specifier of NegP. Neg is filled with an abstract morpheme, allowing verb-movement through it. NegP is located between AgrOP and VP. In Norwegian, \textit{ikke} does not block

![Fig. 3. The syntactic structure of the Dutch sentence Jan leest het boek niet.](image)
verb-movement. Therefore, *ikke* is considered the specifier of NegP. Like in English, NegP is positioned between TP and AgrOP.

1.5. Constituent negation

Another way of expressing negation is through what is sometimes called constituent negation. This may be used as a marked form of negation. In English, for example, one may produce a negative sentence like in (4) for contrastive meaning:

(4) He eats *not* the apple (*but the banana*).

In case of sentence (4), negation only has scope over the direct object (narrow focus), instead of negating the entire VP. The syntactic structure of (4) is presented in Fig. 5.

The negation is supposed to be generated VP-internally and is the specifier of the DP. In order to interpret this type of negation, the constituent has to move to NegP [10]. In English, Dutch and Norwegian, the verb is allowed to move overtly or covertly to T and AgrS to check its features in sentences with constituent negation and therefore it is assumed that the specifier of NegP is the landing site for the negated constituent.

![Fig. 4. The syntactic structure of the Norwegian sentence Jens leser ikke boka.](image-url)
Expressing negation through constituent negation is grammatical in English in a simple active sentence, but only when *do* is not inserted and the sentence is extended with a contrastive phrase (see 4). Constituent negation in sentences in the passive form and the present perfect tense is not grammatical:

(5) "The boy has read not the book.
(6) "The book is read not by the boy.

In Dutch, constituent negation is grammatical in sentences in the active and present perfect tense, but not in passives:

(7) De jongen leest *niet* het boek.
Lit. The boy reads *not* the book.
(8) De jongen heeft *niet* het boek gelezen
(sentential negation: de jongen heeft het boek niet gelezen).
Lit. The boy has *not* the book read.
(9) "Het boek wordt gelezen niet door de jongen
(sentential negation: het boek wordt niet gelezen door de jongen).
Lit. The book is read not by the boy.

In Norwegian, in active negative sentences there is no difference between the superficial form of sentential and constituent negation:

(10) Gutten leser ikke boka.
The boy reads not the book.

![Fig. 5. The syntactic structure of constituent negation in English.](image-url)
However, constituent negation is not grammatical in sentences in the perfect present tense and passive form:

(11) *Gutten har malt ikke veggen
    (sentential negation: gutten har ikke malt veggen).
    Lit. The boy has painted not the wall.
(12) *Koppen blir knust ikke av jenta
    (sentential negation: koppen blir ikke knust av jenta).
    Lit. The cup is broken not by the girl.

1.6. Agrammatic comprehension

According to Zurif [11], Grodzinsky [3,12] and others, the syntactic comprehension deficit in agrammatic aphasia emerges only with semantically reversible sentences which contain NPs that have been moved from their original position. Examples of sentences that are problematic for agrammatics are, for example, passives (13) and object-cleft sentences (14):

(13) The woman is kissed by the man.
(14) It is the man that the woman kissed.

Grodzinsky [3,12] has formulated the Trace-Deletion Hypothesis (TDH) to account in a structural way for this deficit. According to the TDH, agrammatic comprehension is caused by a deletion of traces in theta-positions. To assign a thematic role to the moved NP, the patient will use a Referential Strategy, which basically means that the first referential NP in the sentence will receive the thematic role of Agent. In the examples above, the other NPs will receive their Agent role by the structure, as they have not been moved. Consequently, both NPs will receive the Agent-role and agrammatic patients will perform at chance-level in a comprehension task.

What does the TDH predict for comprehending negative sentences? Negation is normally not involved in argument movement. Therefore, with respect to the TDH, the comprehension of negative sentences should be preserved in agrammatic aphasics (see also Grodzinsky and Finkel [13]).

1.7. Agrammatic production

No explicit theories have been formulated about the production of negation by agrammatic patients. There are some more general syntactic accounts of agrammatism, from which predictions may be distilled. Ouhalla [14] describes agrammatic production as the inability to make functional projections. The agrammatic patients speak in VPs, and no projections higher in the tree are made. This suggests that sentential negation, with NegP being a functional projection outside the VP, is problematic for agrammatics.
Hagiwara [15] claims that elements from functional categories are more susceptible to impairment than elements from lexical categories. Furthermore, she hypothesizes that the lower the position of a functional head and its projection in the sentence structure hierarchy, the more accessible it is to an agrammatic patient.

1.8. Hypotheses for comprehension and production of negative sentences in agrammatism

According to the TDH [3,12], comprehension of negative sentences will be preserved, regardless of the syntactic status of negation. Ouhalla [14] predicts production problems for all agrammatic aphasic speakers, since negation is always a functional category. Hagiwara’s theory [15] predicts that the higher a functional projection is in the syntactic tree, the less accessible it will be. This suggests that English and Norwegian patients will be more impaired (NegP between TP and AgrOP) than Dutch patients (NegP between AgrOP and VP).

Apart from the status of negation as a functional projection and its position in the syntactic hierarchy, the present study focuses on the internal structure of NegP. The central question is: do the syntactic properties of negation, that is, the status of negation being a functional head or a specifier, influence the comprehension and/or production of negative sentences in agrammatic aphasia?

2. Methods

2.1. Subjects

One Canadian–English and one British–English patient, three Dutch and two Norwegian agrammatic aphasics participated in this study. All patients were

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Gender</th>
<th>Eti.</th>
<th>Mpo</th>
</tr>
</thead>
<tbody>
<tr>
<td>English:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LB</td>
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<td>Female</td>
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<td>84</td>
</tr>
<tr>
<td>PB</td>
<td>67</td>
<td>Female</td>
<td>CVA left</td>
<td>72</td>
</tr>
<tr>
<td>Dutch:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCL</td>
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<td>CVA left</td>
<td>24</td>
</tr>
<tr>
<td>TV</td>
<td>46</td>
<td>Male</td>
<td>CVA left</td>
<td>24</td>
</tr>
<tr>
<td>RB</td>
<td>35</td>
<td>Female</td>
<td>CVA left</td>
<td>24</td>
</tr>
<tr>
<td>Norwegian:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER</td>
<td>54</td>
<td>Male</td>
<td>CVA left</td>
<td>52</td>
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<tr>
<td>IN</td>
<td>31</td>
<td>Male</td>
<td>CVA left</td>
<td>12</td>
</tr>
</tbody>
</table>
diagnosed as Broca’s aphasics using standard aphasia tests (WAB for Canadian patient, BDAE for English patient, AAT for Dutch patients and several standard tests for the Norwegian patients). They were all classified as agrammatic by their speech therapists, clinical linguists and the testers on the basis of their adequate auditory comprehension in conversation and their telegraphic speech output (e.g. omissions and substitutions of inflections, determiners and pronouns). Unfortunately, no CT or MRI scans are available, but all patients suffered from a right hemiplegia, indicating that left frontal brain damage is involved. Table 1 displays information about the patients. Seven control subjects collaborated on this study; two English, three Dutch and two Norwegian speaking subjects. The controls were selected to match the patients for sex, age and level of education. All control subjects were healthy and native speakers of the languages in which they were tested.

2.2. Test materials

Three experiments were developed to investigate comprehension and production of negative sentences in English, Dutch and Norwegian. Only sentences that could be literally translated into the three languages were included, in order to keep the items the same in the three versions of the test. The English sentences are given in the Appendix.

2.2.1. Comprehension

The goal of this task is to investigate comprehension of negative sentences compared to affirmative sentences. A simple spoken-sentence-to-picture matching test has been developed. A negative or affirmative sentence is read to the patient and s/he is asked to choose one out of two pictures. Each picture contains one subject and two objects. One picture matches the sentence, the other is the negative or affirmative counterpart. The test consists of 36 items, 18 are negative sentences, 18 are positive control sentences. An example is given in Fig. 6.

2.2.2. Production

For production, two sentence-anagram tests were developed, although constructing sentences in an anagram task is different from oral production. The disadvantage, however, of testing negative sentences through oral production tasks is that patients may use a verb different from the target, resulting in an affirmative sentence, instead of a negative one. This possibility is ruled out by using anagram tasks. The verbs have been controlled for frequency.

The differences between the three languages interfered with the anagram tests: the English active negative sentences contain one more morpheme (hence, one more card) than the Dutch and Norwegian active negative sentences. It was decided not to include an extra card (e.g. with an adverb printed on it) because this would change the design of the experiments.
2.2.2.1. The sentence-anagram task with pictures. This task has been used to evaluate whether negative sentences are more difficult than affirmative ones and whether and how negation is used. Furthermore, this task investigates whether patients use negation when this is elicited by the picture. The test consists of 18 items, 9 negative, 9 affirmative control sentences. The anagram cards with the negation morpheme(s) are presented with every picture and the patient has to decide whether or not to use the negation. The cards are presented in a semi-random order, but never in the grammatical order. Each picture shows a person or animal doing something. In each picture two objects are depicted to make the negative sentence more plausible. Two examples of the test pictures are given in Fig. 7.

Fig. 6. Two examples of the sentence comprehension test: the girl throws the stick and the man does not read the newspaper.
2.2.2.2. The sentence-anagram task without pictures. The goal of this test is the same as above, but with this test, syntactically more complex sentences are elicited. The task consists of 30 items; half of them are negative, half of them are affirmative control sentences. Three structures are tested: 10 active, 10 passive and 10 present perfect tense sentences. The patient is asked to use all cards, so he is obliged to construct a negative sentence when negation is included, whereas in the anagram test with pictures, not all cards had to be used. An example of this test is:

Target sentence: the mouse is not caught by the cat.
Anagram cards: [the mouse] [is] [not] [caught] [by the cat].

In the passives, the by-phrase was printed on one card in order not to complicate the task by letting the patient choose which NP is agent or theme.
Fig. 7. Two examples of the sentence anagram test with pictures: *the woman irons the pants* and *the girl does not eat the banana*.
2.2.2.3. Scoring. Only syntactic errors are counted in the anagram tasks; semantic reversibility errors are not scored. Naturally, the absence of negation in a target negative sentence, or the presence of negation in a target positive sentence are scored as errors. For all errors, the construction made by the patient was written down and analyzed (see Results section). The order in which the tests were presented was the same for each patient: first the sentence anagram task with pictures, then the anagram task without pictures and finally the comprehension task.

3. Results

None of the normal controls made errors on any of the tests; these data will not be further discussed. The performance of the agrammatic patients will be presented per language. At the end of this section, the performances will be compared cross-linguistically. Since the number of observations is relatively low and proportional scores have been used, non-parametric testing is performed (Wilcoxon-tests for comparisons within groups, Mann–Whitney U-tests for comparisons between groups).

3.1. Comprehension

In Table 2, the results on the comprehension test are given. All Dutch aphasics, one of the English (LB) and one of the Norwegian (ER) patients perform rather well on this test. One of the English (PB) and one of the Norwegian patients (IN) score at chance-level (44 and 50%) on the negative sentences, but better at the affirmative sentences. For the entire group, there is no significant difference

Table 2
The number of errors of the patients on the sentence comprehension test. The proportional scores are given in parentheses

<table>
<thead>
<tr>
<th>Language</th>
<th>Negative</th>
<th>Affirmative</th>
</tr>
</thead>
<tbody>
<tr>
<td>English:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LB</td>
<td>1 (0.06)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>PB</td>
<td>8 (0.44)*</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Dutch:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCL</td>
<td>1 (0.06)</td>
<td>2 (0.11)</td>
</tr>
<tr>
<td>TV</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>RB</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Norwegian:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER</td>
<td>2 (0.11)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>IN</td>
<td>9 (0.50)*</td>
<td>6 (0.33)</td>
</tr>
</tbody>
</table>

*Chance-level.
between the affirmative and negative sentences \( z = -1.27, p = 0.204 \), although the individual differences are noteworthy.

### 3.2. Production

#### 3.2.1. The English patients

The performances of the English patients are displayed in Table 3. The English patients perform strikingly similar, both quantitatively and qualitatively. In the anagram task with pictures they did not use *not*, except for once. PB constructs one sentence with *not*, but without *do*: "the dog scratches *not* the man" (constituent negation). In the other eight target negative sentences, PB leaves out *not*, like LB always does. Both patients sometimes use *does* in the target negative sentences without *not* (LB four times, PB three times). They never use *does* in the target affirmative sentences.

In the anagram task without pictures, in which all cards should be used, both patients display the same pattern of constructing the negative target sentences. They place *not* after the main verb instead of before: *the boy does congratulate not the girl; the dinner is cooked not by the man; the cat has followed not the woman*. This suggests that they apply constituent negation instead of sentential negation. LB does so 87\% of the time; in the two other sentences, she places *not* at the end. PB once indicates that she is unable to form the sentence; the other errors concern constituent negation (86\%).

The English patients are significantly more impaired in constructing the negative than the affirmative sentences \( z = -2.12, p = 0.034 \).

#### 3.2.2. The Dutch patients

The results of the Dutch patients are displayed in Table 4. In the sentence-
anagram task with pictures, RB constructs four out of nine negative sentences with constituent instead of sentential negation: *de hond bijt niet de jongen* (instead of *de hond bijt de jongen niet*: *the dog does not bite the boy*). Although this word order may have been triggered by the pictures because they depict two direct objects, neither the normal controls, nor the other agrammatics form this construction.

In the sentence-anagram task without pictures, all three patients make errors with the negative sentences, most errors being grammatical sentences with constituent, instead of sentential negation. Again, this type of negative sentence is normally used to emphasize the direct object. Including these ‘errors’, the Dutch patients are significantly worse in constructing negative than affirmative sentences ($z = -2.12, p = 0.034$); when these sentences are counted as correct, the difference is not significant ($z = -1.50, p = 0.134$).

3.2.3. The Norwegian patients

The results of the Norwegian patients are given in Table 5. On the task with pictures, ER makes one error on the negative sentences: *gutten ikke ser katten* (lit. *the boy not sees the cat*) instead of *gutten ser ikke katten* (lit. *the boy sees not the cat: the boy does not see the cat*). IN makes three errors on the negative sentences, he omits the negation two times and once he places it at the end of the sentence.

On the version without pictures, all errors made by ER are constituent negation, whereas IN makes multiple errors in each sentence. IN also makes many errors with the affirmative sentences in this task. For the Norwegian patients, there is no significant difference between the negative and the affirmative sentences ($z = -1.50, p = 0.134$).

Table 4
The number of errors of the Dutch speaking patients. The proportional scores are given in parentheses

<table>
<thead>
<tr>
<th></th>
<th>HCL</th>
<th>TV</th>
<th>RB</th>
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<tbody>
<tr>
<td>Negative sentences:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>4 (0.44)</td>
</tr>
<tr>
<td>Anagram---picture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actives</td>
<td>0 (0.00)</td>
<td>4 (0.80)</td>
<td>4 (0.80)</td>
</tr>
<tr>
<td>Passives</td>
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<td>2 (0.40)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Perfect present tense</td>
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<td>4 (0.80)</td>
<td>5 (1.00)</td>
</tr>
<tr>
<td>Affirmative sentences:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Anagram---picture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actives</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Passives</td>
<td>0 (0.00)</td>
<td>2 (0.40)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>Perfect present tense</td>
<td>0 (0.00)</td>
<td>2 (0.40)</td>
<td>0 (0.00)</td>
</tr>
</tbody>
</table>
3.2.4. A cross-linguistic comparison

Table 6 displays the proportional scores of errors of all patients. A comparison of the performances on the affirmative control sentences in the anagram tasks reveals no significant differences between the three patient groups (English–Dutch:

<table>
<thead>
<tr>
<th></th>
<th>ER</th>
<th>IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative sentences:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>1 (0.11)</td>
<td>3 (0.33)</td>
</tr>
<tr>
<td>Actives</td>
<td>1 (0.20)</td>
<td>2 (0.40)</td>
</tr>
<tr>
<td>Passives</td>
<td>5 (1.00)</td>
<td>1 (0.20)</td>
</tr>
<tr>
<td>Perfect present tense</td>
<td>2 (0.40)</td>
<td>5 (1.00)</td>
</tr>
<tr>
<td>Affirmative sentences:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0 (0.00)</td>
<td>1 (0.11)</td>
</tr>
<tr>
<td>Actives</td>
<td>0 (0.00)</td>
<td>1 (0.20)</td>
</tr>
<tr>
<td>Passives</td>
<td>1 (0.20)</td>
<td>5 (1.00)</td>
</tr>
<tr>
<td>Perfect present tense</td>
<td>0 (0.00)</td>
<td>1 (0.20)</td>
</tr>
</tbody>
</table>

Table 6 Proportional error scores for all patients

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>Dutch</th>
<th>Norwegian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LB</td>
<td>PB</td>
<td>HCL</td>
</tr>
<tr>
<td>Comprehension:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative sentences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0.06</td>
<td>0.44</td>
<td>0.06</td>
</tr>
<tr>
<td>Actives</td>
<td>0.00</td>
<td>0.00</td>
<td>0.11</td>
</tr>
<tr>
<td>Affirmative sentences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
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<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Actives</td>
<td>1.00</td>
<td>0.80</td>
<td>0.00</td>
</tr>
<tr>
<td>Perfect present tense</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Production:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative sentences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Anagram+picture</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Actives</td>
<td>0.20</td>
<td>0.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Perfect present tense</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean negative</td>
<td>0.95</td>
<td>0.44</td>
<td>0.46</td>
</tr>
<tr>
<td>Mean affirmative</td>
<td>0.05</td>
<td>0.07</td>
<td>0.21</td>
</tr>
</tbody>
</table>
The results are interpreted within the syntactic framework, given in the introduction. First the findings on the comprehension test will be discussed. According to the TDH of Grodzinsky [3,12], traces in theta-positions are deleted from syntactic representation resulting in misinterpretation of semantically reversible sentences in which the NP has moved out of its original position. Negation is normally not involved in theta-role assignment, and as a consequence, it is expected that the comprehension of negation should be relatively intact. Grodzinsky and Finkel [13] tested negative sentences in a grammaticality judgment task in English speaking agrammatic patients and found that these patients correctly judge the (un)grammaticality of negative sentences. This is in line with our present findings. Dutch patients TV and RB do not make any errors in comprehending both affirmative and negative sentences. LB, HCL and ER are relatively undisturbed on the task: they only make one or two errors in comprehending the negative sentences. IN has more problems with comprehension in general. One English patient PB shows a specific difficulty with comprehending negative sentences (8/18 errors in the negative sentences versus zero errors in the positive sentences). The majority of the sentences that she misinterpreted were semantically reversible sentences. The negative sentences that LB and ER misinterpreted were semantically reversible as well. It cannot be the case that semantic reversibility itself caused the problems for PB, LB and ER because they did not have any problems interpreting the positive semantically reversible sentences. Thus, the results of patients LB, HCL, TV, RB and ER support the assumption that comprehension of negation is relatively undisturbed. IN seems to have more trouble with comprehension in general, and his error pattern does not contradict the hypothesis since the errors are equally distributed between the two
types of sentences. Only PB is specifically impaired in comprehending negative sentences, but her performance is an exception. In sum, the results of the comprehension test do not contradict the hypothesis based on Grodzinsky’s TDH: comprehension of sentences containing sentential negation is not impaired in agrammatism, as it does not involve movement of argument NPs.

The English patients are significantly worse in constructing negative sentences than the Dutch and Norwegian patients, but no difference is found between the Dutch and Norwegian patients. Before discussing these results, we would like to make a few remarks on possible limitations that could interfere with comparing the data. The observed differences in performance on the anagram tasks between the three patient groups cannot be accounted for by assuming that the English patients are more impaired than the Dutch and Norwegian aphasics, because in that case a better performance would be expected overall. No such difference is found for construction of affirmative sentences. It could be the case that this task is easier for the Dutch and Norwegian, because some of the sentences contain fewer words than the English counterparts. This, however, does not hold for the present perfect tense and passives: the number of constituents is the same here and the English patients perform worse than the Dutch. As can be seen in Table 6, Norwegian patient IN almost always performs worst of all patients on the affirmative sentences, both in comprehension and production, indicating that he is more severely affected by his aphasia. However, a comparison between the performances on the construction of negative sentences of IN and English patients LB and PB, who perform poorest of all patients, reveals that only once he scores worse than them (present perfect tense; PB 80% and IN 100% incorrectly). This makes clear that even though IN seems to be more severely impaired than the other patients, a cross-linguistic comparison still reveals specific differences between the patient groups.

The results on the production tasks (the English being significantly worse on negative sentences but the Dutch and Norwegian patients performing the same) are in contradiction with the theory of Ouhalla [14] that predicts equal levels of performance for patients in the three languages, since sentential negation is always a functional projection. Neither does Hagiwara’s description [15] of agrammatic impairment fit the data: she predicts that the English and Norwegian patients will perform worse than Dutch patients, as NegP is higher in the English and Norwegian syntactic tree.

Thus it seems that the data cannot be fully explained in terms of the position of NegP in the syntactic tree. Two things, however, should be borne in mind. First, the data are obtained from anagram tasks, which is different from oral production (although Hagiwara’s hypothesis is broader than speech production). Second, the number of patients that have been tested is very small: only two patients in English and Norwegian, and three in Dutch. Nevertheless, we would like to offer an alternative explanation, based on the internal organization of NegP in the three languages, rather than its position in the tree.

In English, Neg is filled with the negation morpheme *not*, and there is a mutual dependency with V and AgrS. In Dutch and Norwegian, insertion of negation
does not influence V-movement, since niet and ikke are specifiers of NegP. Therefore, it is proposed that agrammatic aphasics have difficulties producing negative sentences when the negation morpheme is head of NegP, that is, when negation is related to AgrS. Thus, it is suggested that it is not the position of NegP in the tree, as proposed by Hagiwara [15], but rather the internal organization of NegP, that influences the production of negative sentences of agrammatic patients. This means that it is the negation’s status as a functional head that is problematic to the agrammatics.

This does not mean, however, that negation is always accessible when it is a specifier. The Dutch patients are more impaired on the negative than on the affirmative sentences, when constituent negation is counted as an error. It is remarkable that, regardless of the status of the negation word, all patients tend to solve the problem in the same way: all but one resort to constituent negation (English: LB 54%, PB 56%; Dutch: HCL 80%, TV 60%, RB 89%; Norwegian: ER 100%, IN 0%). Apparently, this is easier than sentential negation and this may be explained by the fact that the scope is narrowed, which makes constituent negation easier to apply than sentential negation, and/or the fact that constituent negation concerns the specifier (it does not block V-movement in any of the languages involved). Notice that in Dutch constituent negation is perfectly grammatical, although marked. It was considered to count constituent negation as an error, because it was not used by the normal speakers. In English and Norwegian, however, constituent negation is ungrammatical when the sentence is not extended with a contrasting phrase: cf. *the boy eats not the banana and the boy eats not the banana, but the apple.*

Interesting in relation to the observed preference for constituent negation is the finding from van Zonneveld [16] who describes that young Dutch children (2;0–2;8) tend to produce sentences with constituent negation (e.g. die wil niet dat dingetje; lit. he wants not that little thing; he does not want that little thing versus die wil dat dingetje niet) instead of sentential negation. Furthermore, Wexler [17] reports on acquisition data from Korean in which young children (around 2;0–3;0) sometimes produce negative utterances where the negation precedes the object rather than the verb:

(15) Adult: Subj Obj Neg V (e.g. na pyeng an kay-ss-e; Lit. I bottle not break).
(16) Child: Subj Neg Obj V (e.g. na an pyeng kay-ss-e; Lit. I not bottle break).

The example in 16 can be taken as a form of constituent negation which is ungrammatical in adult Korean. It is not possible to compare negative sentences in English child language with the aphasic data of the anagram tasks to investigate use of constituent negation. Young English children (around 2;0–3;0)

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go through a stage where they omit do-support; the so-called medial negation phase, e.g. he not eat apple [cf. 18]. However, the English patients were asked to include does in their constructions, making a comparison with acquisition data troublesome. Unfortunately, to our knowledge, no Norwegian child data have been described with respect to negative sentences. Thus, acquisition data show that constituent negation is not only used by agrammatic aphasics, but also by young children. More research is warranted to take a closer look at this parallel.

To investigate the production of negative sentences in agrammatism in more detail, a picture description task was developed to elicit negatives in a less constricted framework compared to the anagram tasks. This proved to be problematic as the patients hardly produced any negative constructions spontaneously. Therefore, samples of spontaneous speech from other agrammatic aphasics, taken out of the Menn and Obler corpus [19], have been analyzed on the structure of negative sentences. Unfortunately, no Norwegian data are available in this database. The two English samples only contain five negative constructions. As these utterances were either incomplete (not good), intransitive (I can't, I don't and I can't speak) or a fixed expression (I didn't pay much attention) they do not tell much about the use of negative sentences in English agrammatic spontaneous speech with regards to a preference for either constituent or sentential negation. The same problem was encountered when analyzing the Dutch samples from the Menn and Obler [19] source book. Six other samples of agrammatic patients, described by Bastiaanse and Jonkers [20], were investigated which included 36 negative utterances consisting of at least a verb and the negation morpheme niet, but only two of these also contained another constituent, which is necessary to investigate a preference for constituent or sentential negation. In both of these cases the patient used sentential negation, but the small number of negative sentences does not allow us to draw any conclusions.

In summary, the results of the present study, in which comprehension and production of negative sentences was tested, show that comprehension is relatively unaffected. In production, the differences found between the three different languages suggest that the degree in which the construction of negative sentences is impaired is related to the internal structure of NegP in the patient’s language. When the negation word is a functional head it is more difficult for agrammatic patients to construct negative sentences than when it is in the specifier. Furthermore, all three patient groups tend to resort to constituent negation when they make errors, a phenomenon that can also be observed in child language.

In a previous study [9], it was shown that agrammatic speakers have problems with the production of another functional head, I (AgrS), when there is a dependency relation with V, as in Dutch matrix clauses. Agrammatic patients are not able to produce inflected verbs correctly in this position. When there is no movement from V to I (as in Dutch embedded clauses) and, hence, no relation between V and I, agrammatics are perfectly able to produce inflected verbs. It is not yet clear whether all functional heads are difficult to agrammatics, as suggested by Grodzinsky [3] or only functional heads that have a direct relation
with V and/or I, nor do we know whether V and I can each be the source of the problem\(^5\) or that it is the dependency relation between these two that is crucial. Further research to negation in other languages and to (direct and indirect) relations between other functional heads is needed to reveal more about the syntactic impairment that underlies agrammatic speech.

Acknowledgements

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Appendix A. The target sentences of the production tasks and the sentences of the comprehension task

Target sentences anagram task with pictures:
1. The boy does not see the cat.
2. The woman greets the boy.
3. The boy does not throw the stick.
4. The man hits the boy.
5. The girl does not eat the banana.
6. The man reads the newspaper.
7. The man does not drink the wine.
8. The woman irons the pants.
9. The cat does not follow the girl.
10. The woman films the man.
11. The girl does not do the dishes.
12. The dog bites the boy.
13. The man does not watch the policeman.
14. The woman knits the sock.
15. The dog does not scratch the man.
16. The man cuts the tomato.

\(^5\) Friedmann and Grodzinsky [21] suggest that it is not the functional head I as a whole that is problematic for agrammatic, but Tense, whereas AgrS is relatively intact.
17. The boy draws the house.
18. The girl does not pat the cat.

Target sentences anagram task without pictures:
1. The cat has not scratched the woman.
2. The man has not stolen the car.
3. The girl breaks the cup.
4. The woman is scratched by the cat.
5. The man does not milk the cow.
6. The girl is congratulated by the boy.
7. The song is not played by the girl.
8. The woman has not painted the wall.
9. The cat catches the mouse.
10. The girl has played the song.
11. The car is stolen by the man.
12. The boy throws the ball.
13. The boy does not congratulate the girl.
14. The dinner is not cooked by the woman.
15. The cat has caught the mouse.
16. The woman has cooked the dinner.
17. The wall is painted by the woman.
18. The cat does not scratch the woman.
19. The boy has thrown the ball.
20. The cow is milked by the man.
21. The man does not steal the car.
22. The woman does not paint the wall.
23. The girl plays the song.
24. The cup is not broken by the girl.
25. The boy has not congratulated the girl.
26. The woman cooks the dinner.
27. The man has not milked the cow.
28. The ball is not thrown by the boy.
29. The girl has broken the cup.
30. The mouse is not caught by the cat.

Sentences comprehension task:
1. The woman does not greet the girl.
2. The woman draws the flower.
3. The woman does not film the man.
4. The boy does not see the dog.
5. The girl throws the stick.
6. The girl does not eat the apple.
7. The woman hits the boy.
8. The woman watches the policeman.
9. The man does not read the newspaper.
10. The boy washes the dishes.
11. The man does not cut the tomato.
12. The boy pats the cat.
13. The girl sees the cat.
14. The dog does not scratch the woman.
15. The grandmother knits the sock.
16. The boy does not throw the ball.
17. The man does not hit the girl.
18. The woman reads the book.
19. The man does not watch the clown.
20. The cat bites the girl.
21. The girl does not pat the dog.
22. The boy does not draw the house.
23. The man greets the boy.
24. The woman irons the dress.
25. The girl does not do her homework.
26. The boy eats the banana.
27. The woman does not knit the sweater.
28. The woman drinks the wine.
29. The cat does not follow the man.
30. The man does not iron the pants.
31. The man films the dog.
32. The dog does not drink the milk.
33. The woman cuts the bread.
34. The man does not drink the milk.
35. The dog follows the boy.
36. The cat scratches the man.

References