Chapter 3

Verb and noun processing: Overall results

3.1. Introduction

This chapter concerns the overall scores of the different tests of verb and noun processing that were administered in the Broca’s and anomic aphasics. The quantitative scores will be compared to the scores of the normal controls. This will give an indication of the problems the aphasics encounter with verb retrieval in comprehension and production. With respect to verb and noun production, the results will be used to consider a possible (double) dissociation in problems with verbs and nouns in the different types of aphasics. As was described in chapter 1, according to some authors agrammatic patients have more problems with verbs than nouns, whereas for anomics the opposite holds (e.g. Miceli et al., 1984). Results found by Williams and Canter (1987) are not in line with a double dissociation. They found a specific deficit for verbs as compared to nouns in all the aphasics they tested. Basso et al. (1990) claimed that no verb-noun dissociation exists in aphasia. They reported comparable scores for nouns and verbs in different types of aphasics.

The results of the different tests will be presented in the next two sections. The first section takes verb comprehension into account, the second, noun and verb production. The different aspects of verbs that were considered in the present study, will be discussed in two further chapters. However, the effect of frequency on verb retrieval will already be regarded in section 3.5., because an effect of frequency could interfere with other possible influences on verb retrieval. In the last two sections, the results will be summarized and discussed. The individual subject scores for the different subtests are given in Appendix III.
3.2. Verb comprehension

Verb comprehension was tested in the 15 Broca’s aphasics, 19 anomics, and 15 controls, using a verb-to-picture matching task for verb retrieval in isolation, and a sentence-to-picture matching task for verb retrieval in sentence context. In table 3.1. the scores on both tests are presented.

<table>
<thead>
<tr>
<th></th>
<th>in isolation</th>
<th>in sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROCA’S APHASICS (N=15)</td>
<td>51.6 (30-60)</td>
<td>54.9 (42-59)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>7.7</td>
<td>4.3</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOMICS (N=19)</td>
<td>55.5 (39-60)</td>
<td>57.0 (51-59)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>5.0</td>
<td>2.5</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROLS (N=15)</td>
<td>59.5 (58-60)</td>
<td>59.2 (58-60)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1.: Mean, range, and standard deviation (s.d.) of the verb comprehension scores

The quantitative and the qualitative analysis of the results in word comprehension will be given in section 3.2.1., the analysis of the sentence comprehension scores will be considered in section 3.2.2.

3.2.1. Verb comprehension at the word level

Quantitative analysis

Verb comprehension at the word level was relatively well preserved in the aphasics, but there were still some differences between the group scores. A ONEWAY analysis of variance revealed a significant effect for subject
group \((F(2,46) = 8.26, \ p<0.001)\). A post-hoc analysis showed that the controls performed significantly better in verb comprehension than both the Broca’s aphasics and the anomics. The anomics comprehended verbs significantly better than the Broca’s aphasics.

**Qualitative analysis**

The results of the qualitative analysis of the verb comprehension test are shown in figure 3.1. for the Broca’s and anomic aphasics. The scores of the normal controls were at ceiling level and therefore no qualitative analysis has been performed on their data. In the test, three distractors could be pointed to: a semantically related verb (distractor verb), a semantically related noun (distractor noun 1), and a noun that was semantically related to the distractor verb (distractor noun 2).

A group by error type MANOVA was conducted on these error types. There was a main effect for error type \((F(2,64)=35.81, \ p<0.001)\), but not for group \((F(1,32)=0.04, \ p>0.05)\). Post hoc analysis revealed that if the patients made an error, they pointed more often to the distractor verb than to both kinds of nouns distractors (distractor noun 1: \(t(33)=3.98, \ p<0.001\); distractor noun 2: \(t(33)=8.83, \ p<0.001\)). Distractor noun 1 errors occurred more frequently than distractor noun 2 errors \((t(33)=5.33, \ p<0.001)\).

No group by error type interaction was found \((F(2,64)=0.48, \ p>0.05)\), which means that the distribution in error types was comparable in both types of aphasics.

To summarize, verb comprehension did not present many problems for the aphasics. If an error was made, it mostly concerned the distractor verb.

### 3.2.2. Sentence comprehension

Scores for the sentence comprehension task were depicted in table 3.1. Like verb comprehension in isolation, verb comprehension in sentence context was relatively well preserved in the aphasics. A ONEWAY analysis of variance
revealed an effect for subject group \( (F(2,46)=8.69, p<0.001) \). A post hoc analysis showed a significantly better performance of the controls than of the
Figure 3.1: The distribution of errors in the verb comprehension test in the Broca's aphasics and the anomics. Proportions of errors are depicted.
Broca’s aphasics and the anomics. The anomics were better in verb comprehension in sentence context than the Broca’s aphasics. In sentence comprehension only distractor verb errors could be made. Therefore all errors made by both groups of patients concerned the semantically related verb.

3.3. Noun and verb production

Noun and verb production was tested in an object, and an action naming task. Verb production in sentence context was administered with a sentence construction task. In table 3.2., the results of the different tests of noun and verb production are presented.

<table>
<thead>
<tr>
<th></th>
<th>object naming</th>
<th>action naming</th>
<th>sentence construction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BROCA’S APHASICS</strong> (N=15)</td>
<td>35.7 (26-55)</td>
<td>22.6 (9-46)</td>
<td>24.1 (10-42)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>9.0</td>
<td>10.8</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>ANOMICS</strong> (N=19)</td>
<td>41.0 (12-54)</td>
<td>27.6 (9-50)</td>
<td>30.8 (10-46)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>11.2</td>
<td>11.6</td>
<td>12.7</td>
</tr>
<tr>
<td><strong>CONTROLS</strong> (N=15)</td>
<td>55.3 (50-60)</td>
<td>54.6 (50-59)</td>
<td>53.4 (50-60)</td>
</tr>
<tr>
<td>mean (range)</td>
<td>2.9</td>
<td>2.9</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Table 3.2.: Mean, range and standard deviation (s.d.) of the noun and verb production scores

The quantitative and qualitative analysis of the object and action naming scores will be presented in sections 3.3.1. and 3.3.2. The scores of both tests will be compared in section 3.3.3. Section 3.3.4. considers the scores of the
sentence construction test. A comparison between verb retrieval in isolation and sentence context will be the topic of section 3.3.5.

3.3.1. Object naming

Quantitative analysis
A ONEWAY analysis of variance revealed an effect for subject group (F(2,46)=20.50, p<0.001). A post hoc analysis showed a better performance of the controls than of the aphasics groups. No difference was found in object naming between the Broca’s aphasics and the anomics.

Qualitative analysis
The results of the qualitative analysis for the Broca’s aphasics and the anomics is given in figure 3.2. Examples of semantic paraphasias that were produced are knife instead of axe, and foot for knee. As noun-verb substitutions sawing for saw, and fishing for fishing rod were found. Circumlocutions occurred, for example, for diving board: you dive from it, or paint roller: something to paint with.

It was decided to make a further analysis for the proportions of semantic paraphasias, noun-verb substitutions, and circumlocutions in both groups of aphasics. A group by error type MANOVA was conducted on these error types. There was a main effect for group (F(1,32)=5.79, p<0.05), indicating that the three types of errors occurred more often in the anomics than in the Broca’s aphasics. Also, an effect for error type was found (F(2,64)=17.31, p<0.001). A post hoc analysis revealed that the aphasics produced more semantic paraphasias than circumlocutions (t(33)=5.03, p<0.001), and noun-verb substitutions (t(33)=4.13, p<0.001). Comparable numbers of noun-verb substitutions and circumlocutions were made (t(33)=0.98, p>0.05). No group by error type interaction was found (F(2,64)=0.79, p>0.05), indicating that the Broca’s aphasics and the anomics did not differ with respect to the error types that were investigated.
Figure 3.2.: The distribution of errors in object naming for the Broca's aphasics and the anomics. Proportions of errors are depicted.
3.3.2. Action naming

**Quantitative analysis**

A ONEWAY analysis of variance revealed an effect for subject group (F(2,46)=49.99, p<0.001). A post hoc analysis showed that the controls performed significantly better in action naming than both the Broca’s aphasics and the anomics. The scores of the Broca’s aphasics and the anomics were not significantly different.

**Qualitative analysis**

The proportions of the types of errors that were produced in action naming by the Broca’s aphasics and the anomics are depicted in figure 3.3. Again, the proportion of semantic paraphasias, verb-noun substitutions, and circumlocutions was further analyzed. A group by error type MANOVA was conducted on these proportions. There was a main effect for group (F(1,32)=7.16, p<0.02), but not for error type (F(2,64)=2.44, p>0.05). The effect for group indicates that the three error types occurred more often in the anomics than in the Broca’s aphasics. Additionally, a group by error type interaction was found (F(2,64)=7.78, p<0.002). Post hoc analysis revealed a higher number of verb-noun substitutions in the Broca’s aphasics than in the anomics (t(32)=2.43, p<0.05), whereas circumlocutions and semantic paraphasias occurred more often in the anomics than in the Broca’s aphasics (circumlocutions: t(32)=3.35, p<0.01; semantic paraphasias: t(32)=2.31, p<0.05).

Different kinds of verb-noun substitutions were found in the Broca’s aphasics, like personifications (massaging -> masseur), nominalisations (to play hockey (Dutch: hockeyen) -> hockey), or instruments (bathing -> bath).

Examples of semantic paraphasias and circumlocutions produced by the anomics are brushing for combing, and it’s a kind of sport, not boxing instead of wrestling.
Figure 3.3.: The distribution of errors in action naming for the Broca's aphasics and the anomics. Proportions of errors are depicted.
3.3.3. Action vs. object naming

In this section, a comparison is made between the scores of action and object naming. The scores of these tests are graphically depicted for each group in figure 3.4.

The controls showed comparable scores for action and object naming ($t(14)=1.28$, $p>0.05$). The aphasic groups, however, were better in object than in action naming (Broca’s aphasics: $t(14)=8.25$, $p<0.001$; anomics: $t(18)=6.90$, $p<0.001$).

A look at the scores of the patients who were excluded from the present study, revealed that not only were the 34 Broca’s aphasics and anomics better in noun retrieval than in verb retrieval, but that this was true for
almost every single patient that was tested with the VECTA. In sixty-four patients the action and object naming test was administered and only one patient was slightly better in action naming than in object naming, whereas two patients had equal scores for both tests. All other aphasics had lower scores for action than for object naming.

3.3.4. Sentence construction

The scores for verb retrieval in sentence context were presented in table 3.2. As was described in chapter 2, in sentence construction a count was given according to whether the target verb was produced, not whether the sentence was correct. A ONEWAY analysis of variance revealed a significant effect of subject group for the verb retrieval in sentence context scores (F(2,46)=38.06, p<0.001). A post hoc analysis showed that the controls were significantly better in verb retrieval in sentence context than the Broca’s aphasics and the anomics. The anomics performed better in sentence construction than the Broca’s aphasics.

3.3.5. Action naming vs. sentence construction

Verb production in isolation (action naming) has been compared to verb production in sentence context (sentence construction) in this section. The number of verbs that were retrieved in action naming and sentence construction is graphically depicted in figure 3.5. Verb retrieval in isolation did not differ from verb retrieval in sentence context in the three subject groups (Broca’s aphasics: t(14)=0.80, p>0.05; anomics: t(18)=1.46, p>0.05; controls: t(14)=1.19, p>0.05).

3.4. The effect of frequency on verb retrieval

The scores in action naming and sentence construction of the thirty verbs with
the highest frequency were compared to the scores of the thirty verbs with the lowest frequency. The results are depicted in table 3.3. (page 73).

All subject groups had comparable scores for the low and high frequency verbs in action naming (Broca’s aphasics: t(14)=1.47, p>0.05; anomics: t(18)=0.41, p>0.05; controls: t(14)=0.20, p>0.05). The same was found for sentence construction (Broca’s aphasics: t(14)=1.79, p>0.05; anomics: t(18)=0.71, p>0.05; controls: t(15)=0.31, p>0.05). This means that frequency did not play a role in verb retrieval in the subject groups.
Table 3.3.: Mean, range, and standard deviation (s.d.) of the action naming and sentence construction scores with respect to frequency (LF: low frequency verbs, HF: high frequency verbs).

<table>
<thead>
<tr>
<th></th>
<th>action naming</th>
<th>sentence construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LF</td>
<td>HF</td>
</tr>
<tr>
<td><strong>BROCA’S APHASICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (range)</td>
<td>11.8 (4-24)</td>
<td>10.7 (2-22)</td>
</tr>
<tr>
<td>s.d.</td>
<td>5.5</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>ANOMICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (range)</td>
<td>13.6 (4-24)</td>
<td>14.0 (5-27)</td>
</tr>
<tr>
<td>s.d.</td>
<td>6.0</td>
<td>6.1</td>
</tr>
<tr>
<td><strong>CONTROLS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (range)</td>
<td>27.3 (22-30)</td>
<td>27.4 (25-30)</td>
</tr>
<tr>
<td>s.d.</td>
<td>2.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

3.5. Summary

The results of all subtests of the VECTA of the aphasic groups are summarized in table 3.4. Verb comprehension was better preserved in the anomics than in the Broca’s aphasics, both in isolation and sentence context. Considering verb production, the results in this study revealed that both groups of aphasics had more problems in naming actions than in naming objects. No differences were found between the Broca’s aphasics and the anomics on action and object naming.

With respect to action naming some qualitative differences were found between both types of aphasics. Verb-noun substitutions were the most common type of error in the Broca’s aphasics, whereas in the anomics semantic paraphasias and circumlocutions were mostly found.
Anomics were better in retrieving verbs at the sentence level than the Broca’s aphasics. Comparing verb retrieval in isolation and sentence context, however, showed that sentence context did not influence the ability to retrieve a verb in the aphasics. Comparable scores were found for verb retrieval in action naming and sentence construction. Verb retrieval at the word and sentence level was not influenced by the frequency of the verbs in either subject group.

### Verb comprehension

**between groups**

verbs in isolation: Broca’s aphasics < anomics
verbs in sentence context: Broca’s aphasics < anomics

### Noun and verb production

**between groups**

action naming: Broca’s aphasics = anomics
object naming: Broca’s aphasics = anomics
sentence construction: Broca’s aphasics < anomics

**within groups**

Broca’s aphasics: action naming < object naming
anomics: action naming < object naming

Broca’s aphasics: action naming = sentence construction
anomics: action naming = sentence construction

Table 3.4.: Summary of the performance in word and sentence comprehension, action naming, object naming, and sentence construction in the Broca’s aphasics and the anomics.
3.6. Discussion

Verb comprehension was relatively spared in both types of aphasics, although both the Broca’s aphasics and the anomies did not score perfectly in the two verb comprehension tests. Verb comprehension was, however, much better preserved than verb production. Both verb retrieval in isolation and in sentence context proved to be difficult for the aphasics. Furthermore, the retrieval of nouns led to fewer problems than the retrieval of verbs.

It is observed that the scores of the controls on action and object naming are lower than the control scores in other studies that were mentioned in chapter 1. Mostly, these scores are about 95% correct (e.g. Bates et al., 1991; Thompson et al., 1997), whereas in the present study these scores rose to just above 90% correct. It is assumed that the lower scores in the present study are caused by the very strict method of scoring. Only if the target verb or a clear synonym was presented was the answer correct, and help during the tests was out of the question. This is different from most methods used in the studies that were mentioned. Bates et al. (1991) counted every plausible single word description of a picture as correct. Zingeser and Berndt (1990) used cues if a subject did not give the correct reaction. Thompson et al. (1997) prompted the target verb, if a semantically appropriate but non-target verb was produced. Finally, Williams and Canter (1987) and Basso et al. (1990) counted all reactions that were given by the control subjects as correct for the aphasics. All these procedures led, of course, to higher scores in action and object naming.

The overall results to action and object naming in the aphasics do not support the existence of a double dissociation. It seems fair to conclude that, if verbs and nouns are comparable in meaning and frequency, verbs are more difficult than nouns. This suggests that a specific deficit for verbs as compared to nouns has to be assumed for all aphasics. In the next two chapters, however, the results will be analyzed again to consider the effect of verb type on verb retrieval. These chapters will show that the
assumption that in aphasia a specific deficit for verbs exists, needs reconsideration.

The results of both types of aphasics were compared to the scores of a group of controls in the present study. This was done in order to find out whether the aphasic patients encounter problems in verb comprehension and production. This happened to be the case. Additionally, comparisons were made between the Broca’s aphasics and the anomics. However, this was not done in order to be able to draw conclusions on similarities and differences in the performance of the Broca’s aphasics and the anomics. Both groups of aphasics are not matched for the severity of aphasia and therefore the groups are better not compared. It is interesting, however, to see that action and object naming scores in the Broca’s aphasics and the anomics are comparable, although both types of aphasics suffer from different underlying deficits. In action naming, however, the aphasics differ, when the errors are analyzed qualitatively. Broca’s aphasics produced mostly verb-noun substitutions, whereas in anomics, frequently semantic paraphasias and circumlocutions were found.

In the following two chapters, the effect of verb type within both groups of aphasics will be considered. This means that no comparisons will be made between the different subject groups. The effect of the factors transitivity (chapter 4), and instrumentality and name relation with a noun (chapter 5), will be investigated in verb production. The verbs in the comprehension tests were also matched for these factors. The performance on these tests was, however, almost faultless and therefore it was not appropriate to make an analysis of the influence of verb type meaningful.