The retrieval and inflection of verbs in the spontaneous speech of fluent aphasic speakers

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ARTICLE INFO

Article history:
Received 10 September 2009
Received in revised form 5 February 2010
Accepted 11 February 2010

Keywords:
Fluent aphasia
Spontaneous speech
Verbs

ABSTRACT

Fluent aphasia of the anomic and Wernicke’s type is characterized by word retrieval difficulties. However, in fluent aphasic speech, grammatical deviations have been observed as well. There is debate as to whether these grammatical problems are caused by the word retrieval deficit, by an additional grammatical deficit, or by an integration deficit.

Verbs are an interesting word class in this respect, because they are among the words that are hardest to retrieve for many fluent aphasic speakers and some forms require a considerable amount of grammatical computation. For production of a finite lexical verb, the lexical form and inflection for tense and agreement need to be integrated.

In the present study, the use of lexical verbs in finite and non-finite form in the spontaneous speech of 8 Dutch fluent aphasic speakers was analyzed. The results show that retrieval of lexical verbs decreases when more grammatical information needs to be computed. It will be argued that this is best accounted for in terms of an integration deficit: the more computation is needed to express a relation between a verb and intrasentential (agreement) and extrasentential (tense) information, the more difficult it is to retrieve a normal range of lexical verbs.

1. Introduction

There are some areas in aphasiology that have received only sparse attention: linguistic analysis of spontaneous speech is largely underrepresented, limited attention has been given to verbs

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0911-6044/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jneuroling.2010.02.006
compared to nouns, and grammatical disorders in fluent aphasia have only been studied occasionally. Susan Edwards is one of the few aphasiologists who has devoted attention to spontaneous speech, verbs, and linguistic complexity in fluent aphasia. I belong to the happy few who worked with her on these topics. The present study builds on the findings of our last joint study on comprehension and production of verbs and sentences in Broca’s and Wernicke’s aphasia (Bastiaanse & Edwards, 2004).

1.1. Fluent aphasic speech

The main characteristics of fluent aphasia are word-finding problems and, in the cases of Wernicke’s aphasia and conduction aphasia, the use of (verbal and phonemic) paraphasias and neologisms. The normal speech rate and the obvious word production problems are responsible for fluent aphasia being considered as an impairment at the word level with spared grammatical abilities. In general, aphasiologists agree that the word-finding difficulties in Wernicke’s and anomic aphasia are due to lexical-semantic problems. However, in fluent aphasic speech, grammatical errors do occur, and these are labeled as ‘paragrammatism’. Spoken production is often ungrammatical, because the sentences are incomplete or syntactic structures get intertwined, as in the following example from an individual with Wernicke’s aphasia.

After a while it went like this going all of a sudden improve on this side went on that side. So it is. You have to learn and it got better for me, but then you have to sit and you have to learn to speak and all that kind and what you do. But learning is, I have to learn slowly of course, on one time or the other time and I and I’ve got the idea that I’ve been taken better, you can hear that. [punctuation on the basis of intonation]

 Fluent aphasic narrative speech has been analyzed for several languages. The structures used by fluent aphasic speakers are grammatically less complex and less elaborated than normal (Bastiaanse, Edwards, & Kiss, 1996; Butterworth & Howard, 1987; Gleason et al., 1980). In highly inflectional languages, like Italian and Finnish, inflectional errors have been mentioned as well (Butterworth, Panzeri, Semenza & Ferreri, 1990; Niemi, 1990).

A point of debate is whether the ungrammatical sentences stem from the lexical-semantic problems (e.g., Bird & Franklin, 1996), a monitoring problem (Butterworth and Howard, 1987; Butterworth, Panzeri, Semenza, & Ferreri, 1990), or an additional grammatical and/or integration problem (e.g., Edwards & Bastiaanse, 1998; Niemi, 1990). The present study aims to contribute to this discussion by analyzing the use of verbs in the spontaneous speech of fluent aphasic speakers.

In the next section, some linguistic background on verbs will be provided, followed by a summary of the results of relevant experiments on verb production in fluent aphasia. Then, data on verb production in spontaneous speech from several languages will be presented. Finally, we lay out why and how an analysis of verb production can contribute to the debate on the cause of grammatical errors in fluent aphasia.

1.2. Linguistic background

The present study focuses on verbs, but it is important to realize that there are different types of verbs, that have different functions in sentence production and that are stored differently in the lexicon. First of all, there are lexical verbs, which are considered to be open-class words: they have a meaning and can be used to refer to actions, events et cetera. Lexical verbs can be finite, when they are inflected for tense and agreement (‘he walks’, ‘we walked’), and non-finite, when they are combined with another verb (‘to walk’; ‘walking’, ‘we have walked’).

Second, there are the copular verbs, the most frequent of which is ‘to be’. ‘To be’ is a highly irregular verb in Dutch and the different forms cannot be derived by morphophonological rules. Therefore, it is

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1 In languages other than Dutch and English, the finite verbs may be inflected for other functions, such as aspect and mood.
assumed that ‘is’ has a separate entry from ‘am’ and ‘were’, unlike ‘walks’ and ‘walked’ that are supposed to share their entry and are derived ‘rule-based’. Of course, the fact that forms of ‘to be’ are stored separately is not a characteristic of copulas, but rather of irregular verbs, such as ‘to be’ and most of the modal verbs in Dutch. Copular verbs are closed-class words.

Third, there are the modal verbs. Modal verbs are most often used as finite verbs, but in English, these are only inflected for tense, not for agreement (‘he can’, ‘he could’). In Dutch, the language under study, modal verbs are inflected for both tense and agreement, but, like in English, most modal verbs have irregular inflection paradigms. Therefore, the different forms of the Dutch modal verbs are assumed to be stored as separate entries, like copular verbs. Modal verbs can be used with and without a lexical verb (‘yes, we can’; ‘yes, he can swim’). They are closed-class words.

Fourth, there are the auxiliary verbs, which are always used in combination with other verbs. ‘To have’ in combination with a participle refers to the past, ‘to be’ in combination with a participle denotes the passive voice (‘he is pushed’), and in combination with a gerund the progressive (‘he is pushing’). What auxiliaries have in common with modals and copulas is that they are irregular and highly frequent. The difference is that the auxiliaries ‘to have’ and ‘to be’ are always used in combination with another verb that is inflected (either a participle or a gerund). Auxiliaries are closed-class words.

In sum, lexical verbs are open-class words that have a lexical meaning, just as, for example, nouns. Additionally, they serve a grammatical function, that is, their argument structure determines the sentence structure and their finite forms express the relationship with the subject (agreement) and refer to a time frame (tense). The inflection usually follows a regular paradigm. Modal, copular and auxiliary verbs have hardly any lexical meaning, they are used to express time (in case of ‘to have’, ‘to be’, ‘will’, ‘shall’), possibility (e.g., ‘can’, ‘may’), or a similarity between the subject and the complement (in case of copulas). These verbs are highly frequent and their inflection paradigm is irregular. Notice that some verbs can serve different functions: ‘To be’, for example, can be used as a copula (‘he is happy’), as an auxiliary (‘he is smiling’) and as a lexical verb (‘he is in Amsterdam’).

In Dutch, finite verbs in the matrix clause are in derived position, whereas finite verbs in embedded clauses and all non-finite verbs are in base position, as shown in (1–4).

<table>
<thead>
<tr>
<th></th>
<th>the boy</th>
<th>to</th>
<th>the complement</th>
<th>finite verb</th>
</tr>
</thead>
</table>
| (1) | de jongen | een appel | eet | een appel
|     | the boy  | an apple   | eats |
| (2) | de jongen | een appel | die | een appel
|     | the boy  | an apple   | who |
| (3) | de jongen | een appel | wil | een appel
|     | the boy  | an apple   | wants|
| (4) | de jongen | een appel | heeft| een appel
|     | the boy  | an apple   | has |

1.3. Verbs in fluent aphasia: experimental data

There is a vast body of studies on verb production in agrammatic speech nowadays, but the number of experimental studies on this topic in fluent aphasia is relatively small. It is unclear whether fluent aphasic speakers, like agrammatic speakers, are more impaired in naming actions than objects. According to some studies they are (Bastiaanse & Jonkers, 1998; Kohn, Lorch, & Pearson, 1989; Williams & Canter, 1987), but others show that verbs are better preserved than nouns in fluent aphasia (Berndt, Haendiges, Mitchum, & Sandson, 1997; Miceli, Silveri, Nocenti, & Caramazza, 1988). There are two studies on fluent aphasia that specifically focus on the relation between grammatical complexity and verb production. Bastiaanse and Edwards (2004) studied the production of finite verbs and infinitives in a sentence completion task in (Dutch and English speaking) patients with Broca’s and Wernicke’s aphasia. A picture of an action was presented with a sentence in which the verb was missing. In one test this was a finite verb (‘the boy ... an apple’; target ‘eats’), in another test it was an infinitive (‘the child wants to .... to his mum’; target ‘crawl’). Surprisingly, the pattern of performance of the Broca and Wernicke’s patients was similar: both aphasia groups were significantly more impaired in the
production of finite verbs. However, there was a qualitative difference: when Broca patients made errors in filling in finite verbs, they made inflectional errors (in the example above ‘the boy eating an apple’), whereas the Wernicke patients produced predominantly semantically related verbs which were correctly inflected for tense and agreement (in the example above ‘the boy drinks an apple’). Apparently, the need to inflect a verb for tense and agreement reduced the ability to retrieve the correct forms from the lexicon in this group. Notice that the poor performance of the Dutch Wernicke patients may also have been (partially) caused by the fact that in Dutch the finite verb in matrix clauses is in derived position (as is certainly the case in agrammatic speakers; see Bastiaanse, Hugen, Kos, and Van Zonneveld, (2002)).

In a recent study, McAllister, Bachrach, Waters, Michaud, and Caplan (2009) found that verbs that require a complex sentence structure are difficult to produce for fluent aphasic speakers. They tested the production of sentences with unaccusative and unergative verbs. The unergative verbs were simple intransitive verbs that have an agent as grammatical subject, such as in ‘the boy coughed’. Unaccusative verbs are grammatically complex, because the theme is in subject position, such as ‘the river froze’. Production of sentences with unaccusatives was significantly worse than production of sentences with unergative verbs, again showing that grammatical complexity plays a role in fluent aphasic speech. Problems with sentences with unaccusative verbs have also been found in agrammatic speakers (Bastiaanse & van Zonneveld, 2005; Lee & Thompson, 2004).

1.4. Verbs in fluent aphasia: cross-linguistic data of spontaneous speech

In a study on Dutch, English and Hungarian (Bastiaanse et al., 1996), as well as in a later study on Dutch and English spontaneous speech in fluent aphasia (Edwards & Bastiaanse, 1998), it was found that the number of lexical verbs in each language was normal, but that the variety of these verbs was lower than normal. Additionally, the number of lexical adjuncts was reduced in all languages, and the number of embeddings was low in the English and Hungarian samples.2 Bastiaanse and Jonkers (1998) found that in a group of Dutch fluent aphasic speakers the number of produced verbs was adequate, but, again, that the diversity of lexical verbs was lower than normal. Luzzatti, Ingignoli, Crepaldi, and Semenza (2006) analyzed the spontaneous speech of three fluent aphasic speakers of Italian, two of whom were selectively impaired on action naming compared to object naming. All three had a normal pattern of verb production, both in number and in diversity.

1.5. The contribution of the present study: verbs in spontaneous speech

In an analysis of verb use in spontaneous speech of Dutch fluent aphasic speakers, Bastiaanse and Jonkers (1998) showed that: (1) the proportion of finite verbs produced by anomic speakers is normal; (2) the number of modals and copulas is normal; (3) the number of lexical verbs produced is normal; (4) the diversity of lexical verbs is reduced. These data suggest that there is a lexical problem at stake, not a grammatical problem. However, considering the results of the experiments of Bastiaanse and Edwards (2004) and McAllister et al. (2009), grammatically more complex forms might still be difficult for fluent aphasic speakers to produce. Therefore, the data of Bastiaanse and Jonkers (1998) were re-analyzed with a focus on the interaction of lexical retrieval and grammatical encoding, that is, the interaction between retrieval of lexical verbs and inflection for tense and agreement of these verbs. Since grammatically more complex forms may be more difficult to produce, the hypothesis is that lexical access diminishes when complex verb forms, such as finite lexical verbs, have to be produced. This will show either by a low number or by a low diversity of finite lexical verbs.

2. Methods

2.1. Participants

Eight fluent aphasic speakers (four male and four female), all diagnosed as suffering from mild to moderate anomic aphasia according to the criteria of the Dutch Aachen Aphasia Test (AAT, Graetz, De R. Bastiaanse / Journal of Neurolinguistics xxx (2010) 1–10

2 The reason that no difference was found for Dutch was that the non-brain-damaged speakers hardly used embeddings.
Bleser, & Willmes, 1992), were included in this study. They participated in a larger study on verb and noun retrieval (see Bastiaanse & Jonkers, 1998; Jonkers & Bastiaanse, 2007). As a group, they were significantly worse on action naming than on object naming. All group data are given in Table 1, the individual data are in Appendix A.

For comparison, the spontaneous speech of eight non-brain-damaged (NBD) speakers was analyzed. Their samples were elicited as control data for a study on agrammatic speech (Bastiaanse, Hugen, Kos, & Zonneveld, 2002). These non-brain-damaged speakers were selected to match an average group of aphasic speakers in age, gender and education.

2.2. Materials

The elicitation method of the Aachen Aphasia Test (AAT; Graetz et al., 1992) was used. This is a semi-standardized interview, for which the patients are asked questions like ‘can you tell me how your speech problems started’, ‘can you tell me about the work you used to do?’ and ‘what can you tell me about your last holiday?’ The NBD-speakers were asked to tell about their last illness, their former job and their last holiday.

The spontaneous speech samples were transcribed orthographically and 300 words were tallied, according to the methods of Vermeulen, Bastiaanse and van Wageningen (1989).

2.3. Analysis

All utterances containing a verb were analyzed. In order to disentangle the grammatical and lexical deficits, the following variables were included:

- Finiteness index: the number of clauses containing a finite verb divided by the total number of utterances containing a verb.
- Number of lexical verbs;
- Diversity of lexical verbs: the type-token ratio was calculated; the number of different lexical verbs (the types) was divided by the total number of lexical verbs (the tokens). Lemma counts rather than form counts were used: ‘writes’, ‘wrote’, ‘writing’ were counted as one type (i.e. ‘write’)
- Frequency of lexical verbs; for each verb, the log frequency of the verb lemma was established according to the norms of the CELEX database (Burnage, 1990; the frequencies are per type, not per token).
- Number of modal verbs and copulas in finite form.
- Number, diversity and frequency of finite lexical verbs.
- Number, diversity and frequency of non-finite lexical verbs (infinitives and participles).

The grammatical complexity of verb use was presumed to be reflected by the variable ‘finiteness index’. The proportion of finite verbs shows how well the speaker is able to produce verbs that are inflected for tense and agreement. The variables ‘number of lexical verbs’, ‘diversity of lexical verbs’ and ‘frequency of lexical verbs’ were meant to reflect the retrievability of verbs. If the verb problems in spontaneous speech are due solely to lexical retrieval problems, then the number and diversity of lexical verbs will be equally impaired in finite and non-finite verbs. If, however, the poor use of verbs is due to an integration problem, then finite verbs will be more impaired than non-finite verbs, either in

<table>
<thead>
<tr>
<th>Gender (m/f)</th>
<th>Age</th>
<th>Months post onset</th>
<th>Action naming (54.6)</th>
<th>Object naming (55.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4/4</td>
<td>66.62</td>
<td>19.50</td>
<td>31.62</td>
</tr>
<tr>
<td>Range</td>
<td>50–80</td>
<td>7–37</td>
<td>12–46</td>
<td>26–54</td>
</tr>
</tbody>
</table>
number or in diversity. The patient might overuse modals and copulas in order to produce well-formed finite verbs and to avoid retrieval of lexical verbs. For this reason, the variable ‘number of modals and copulas’ was included.

3. Results

In Table 2, the group results of the analysis are given. Individual data are given in Appendix B. Nonparametric Mann–Whitney–U (between groups) and Wilcoxon (within groups) tests have been used for the comparisons, because the groups are too small for parametric testing.

The ‘finiteness index’ is the same for both groups, indicating that these fluent aphasic speakers are able to use verb forms that are correctly inflected for tense and agreement. Although they use slightly more modals and copulas as finite forms, the difference with the NBD-speakers fails to reach significance.

The number of lexical verbs produced by the fluent aphasic speakers is normal as well, but the diversity of these verbs is low. When the diversity is calculated separately for finite and non-finite verbs, an interesting pattern emerges. For the non-finite verbs, the numbers of types and tokens (and consequently the diversity) is normal. For the finite verbs, the number of tokens is normal as well, but the number of types, and, hence, the diversity of finite lexical verbs, is significantly lower than normal. In fact, in fluent aphasic speech, the diversity of the finite verbs is significantly lower than the diversity of non-finite verbs ($z = -2.197, p = 0.028$) whereas these diversities are the same for the NBD-speakers ($z = 0.210, p = 0.833$).

The lexical verbs produced have the same frequency for the fluent aphasic and the non-brain-damaged group of speakers. The same is true for the non-finite verbs alone. However, the frequency of the finite verbs is significantly higher in the group of fluent aphasic speakers.

4. Discussion

These data show that several aspects of verb production in fluent aphasia are intact. The fluent aphasic speakers:

- (1) are able to produce finite verbs inflected for tense and agreement to a normal extent, as shown by the normal proportion of finite verbs;
- (2) have no problem retrieving lexical verbs in spontaneous speech, as shown by the normal number of lexical verbs they produce;

### Table 2
The results of the spontaneous speech analysis (*p < 0.05). N = 8 for both subject groups.

<table>
<thead>
<tr>
<th></th>
<th>Fluent aphasic speakers</th>
<th>Non-brain-damaged speakers</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>Finiteness index</td>
<td>0.94</td>
<td>0.90–0.98</td>
<td>0.96</td>
</tr>
<tr>
<td>Modals and copulas</td>
<td>15.12</td>
<td>4–21</td>
<td>13.38</td>
</tr>
<tr>
<td>Verb types*</td>
<td>14.88</td>
<td>10–25</td>
<td>20.50</td>
</tr>
<tr>
<td>Verb tokens</td>
<td>29.38</td>
<td>21–39</td>
<td>31.50</td>
</tr>
<tr>
<td>Ttr verbs*</td>
<td>0.51</td>
<td>0.36–0.71</td>
<td>0.65</td>
</tr>
<tr>
<td>Frequency verbs</td>
<td>2.74</td>
<td>2.37–3.05</td>
<td>2.58</td>
</tr>
<tr>
<td>Finite verb types*</td>
<td>7.00</td>
<td>4–12</td>
<td>12.38</td>
</tr>
<tr>
<td>Finite verb tokens</td>
<td>14.63</td>
<td>9–22</td>
<td>17.63</td>
</tr>
<tr>
<td>Ttr finite verbs*</td>
<td>0.48</td>
<td>0.30–0.60</td>
<td>0.71</td>
</tr>
<tr>
<td>Frequency finite verbs*</td>
<td>3.13</td>
<td>2.83–3.52</td>
<td>2.83</td>
</tr>
<tr>
<td>Non-finite verb types</td>
<td>10.13</td>
<td>6–17</td>
<td>10.25</td>
</tr>
<tr>
<td>Non-finite verb tokens</td>
<td>14.75</td>
<td>9–21</td>
<td>13.88</td>
</tr>
<tr>
<td>Ttr non-finite verbs</td>
<td>0.69</td>
<td>0.43–1.00</td>
<td>0.74</td>
</tr>
<tr>
<td>Frequency non-finite verbs</td>
<td>2.55</td>
<td>2.23–3.03</td>
<td>2.54</td>
</tr>
</tbody>
</table>

Please cite this article in press as: Bastiaanse, R., The retrieval and inflection of verbs in the spontaneous speech of fluent aphasic..., Journal of Neurolinguistics (2010), doi:10.1016/j.jneuroling.2010.02.006
have no problem using a normal variety of lexical verbs in spontaneous speech, as shown by the normal type-token ratio on non-finite verbs.

(4) produce lexical verbs that have the same word frequency as the lexical verbs of non-brain-damaged speakers.

The fluent aphasic speakers retrieve a normal variety of lexical verbs with a normal frequency, which is a lexical-semantic ability, and use a normal proportion of finite copular, modal, auxiliary and lexical verbs, which is a grammatical ability in spontaneous speech. This suggests that these two processes, verb retrieval and verb inflection for tense and agreement, function quite well. For the production of a finite lexical verb, the two processes of lexical retrieval, and inflection for tense and agreement have to be integrated.

Note that in Dutch the finite verbs in matrix clauses have to be produced in derived position and this may be an additional complicating factor. The influence of derived word order on the production of finite verbs cannot be analyzed with the present data, because both the aphasic speakers and the NBD-controls produced predominantly matrix clauses. Hence, wherever it is said that verbs that are inflected for tense and agreement are difficult, this should be read as verbs in derived position that are inflected for tense and agreement are difficult. As yet, it is unclear whether it is the inflection for tense or agreement of the derived order that is the source of the problem.

On the basis of the study of Bastiaanse and Edwards (2004), which showed that in an experimental setting the production of finite lexical verbs was more impaired than the production of non-finite lexical verbs, it was hypothesized that in fluent aphasic speech lexical access would diminish when the grammatical form was more complex due to an integration problem. This hypothesis is supported by the data: when lexical verbs have to be inflected for tense and agreement, that is, when intra- and extrasentential computations have to be made, lexical diversity of the verbs decreases and the word frequency of produced verbs increases significantly. This means that the Wernicke patients of the Bastiaanse and Edwards study and the anomic speakers of the present study show the same phenomenon: poor production of finite verbs.

The strategy that these fluent aphasic speakers apply to circumvent this integration problem is to use more frequent verbs and to produce these verbs at a higher rate than normal. In this way, the threshold for a lexical verb is lowered and the verb is easier to retrieve. An extreme example of this is observed in the following sample. This patient was not included in the analysis, but, in fact, his remarkable verb use in spontaneous speech was the inspiration for the present study. The question he answered was ‘can you tell me how your speech problems started?’ The finite lexical verbs are underlined.

only sentences … only sentences … yes beginning that was nothing, basically …. yes, not even not even not even my name not even no numbers nothing and then I thought, well, yes … then I thought … a day I thought then I thought two days well and not even newspapers then I thought okay you can with your legs and arms that is okay but only those sentences and a newspaper that [works not] and then I think well … then I thought again … one day again one day then I thought a week then I thought two. two weeks I thought then and odd and you can do everything. I want3 to story I want and I want very many friends.

In the next sections, it will be discussed how these results relate to the outcomes of the experimental studies and to the spontaneous speech data of Italian fluent aphasic speakers. Finally, the implications for theories on the disorder underlying the grammatical errors in fluent aphasic speech will be discussed.

4.1. Relation to experimental data

The findings of the spontaneous speech analysis are in line with the results of the experiments by Bastiaanse and Edwards (2004) and McAllister et al. (2009). Bastiaanse and Edwards reported that in Dutch ‘to want’ is considered to be a modal verb.
individuals with Wernicke’s aphasia filling in finite verbs in sentence context was more impaired than filling in infinitives and that the main error type was substitution by a semantic paraphasia. The fluent aphasic speakers from the present study all suffered from mild to moderate anomic aphasia, but the results are similar: the low diversity and high frequencies of finite verbs imply that the forms are hard to produce. McAllister et al. showed that sentence production with unaccusative verbs was affected in mild to moderate fluent aphasia. So, both experimental studies demonstrate that complex verb (forms) hamper speech production in fluent aphasia. Sentences with unaccusative verbs are grammatically complex, because the subject of the sentence has a theme role, a role that is usually assigned to the direct object. Finite verb forms are complex because the computations for tense and agreement have to be performed. In fluent aphasia, this grammatical complexity interferes with lexical retrieval. In an experiment, semantic paraphasias are produced, while in spontaneous speech, the diversity of finite lexical verbs diminishes and the frequency of these forms is high. The similarity with agrammatic aphasia is remarkable: grammatically complex verbs (unaccusatives) and verb forms (verbs inflected for tense and agreement) are significantly impaired in both groups. This does not only show in experimentation, but also in spontaneous speech. However, the way the aphasic subgroups deal with the problem is different: agrammatic speakers make predominantly grammatical errors on a test and produce simple verb forms in spontaneous speech, whereas fluent mildly-aphasic speakers make lexical errors on a test and show little variety and a high frequency of their finite verbs in spontaneous speech.

4.2. Relation to verb usage in Italian fluent spontaneous speech

The present study showed a reduced diversity of verbs, which was solely caused by the finite verbs. Luzzatti et al. (2006) did not find a reduced number or variety of lexical verbs in their two fluent aphasic speakers of Italian who had a selective disorder in action naming. Probably, the variety of the finite verbs in these fluent aphasic speakers was normal (Luzzatti et al. did not analyze the finite and non-finite verbs separately, but the overall diversity was normal, whereas in the present study the overall diversity was reduced). Notice that their patients were very similar to the ones in the present study, who were all worse in action than object naming except for one. The reason for this cross-linguistic difference may lie in the nature of Dutch and Italian. Italian is a pro-drop language and Dutch is not. Since the Italian speakers were asked to talk about their speech problems, their job etcetera, it is likely that many subject pronouns have been dropped. It may be the case that pro-drop sentences require less computation than sentences in which the subject is spelled out and agreement relations need to be computed. In fact, when children acquire language, they start with pro-drop sentences in all languages. Pronoun subjects in non-pro-drop languages are acquired relatively late (see, e.g., Hyams & Wexler, 1993). This might be because sentences with pro-drop are grammatically less complex and, therefore, require less processing load than sentences with subject-finite verbs, where agreement computations need to be performed. If this is the right explanation, the diversity of finite verbs in sentences with spelled-out subjects should be lower than in pro-drop sentences. However, this explanation is rather speculative and needs empirical testing.

4.3. Implications for locus of the deficit

As pointed out in the Introduction, there is a debate in the literature as to whether fluent aphasic speakers have an isolated word retrieval deficit that may result in grammatical errors (Bird & Franklin, 1996), a monitoring problem (Butterworth and Howard, 1989; Butterworth et al., 1990), an additional grammatical problem (Edwards & Bastiaanse, 1998; Niemi, 1990), or a problem integrating grammatical and lexical information (Bastiaanse & Edwards, 2004; McAllister et al., 2009).

What speaks against the claim that the problems with finite verbs are due to a pure word retrieval problem is that the fluent aphasic patients in the present study do not have a verb retrieval problem in spontaneous speech: both the number and the diversity of non-finite verbs is normal. A pure grammatical impairment causing the reduced diversity is not very likely either: if this were the case, the proportion of finite verbs would have been lower, as in agrammatic speech (Bastiaanse et al., 2002). These fluent aphasic speakers are capable of producing a normal variety of lexical verbs as long as these
are not finite. They are also able to produce finite verbs, as shown by their normal finiteness index. However, producing lexical finite verbs raises a problem, which is reflected by a reduced variety and a high frequency of these items. This aggregate of phenomena can be explained by two different deficits. It might be that lexical retrieval is impaired and when grammatical complexity increases, lexical retrieval diminishes, resulting in highly frequent verbs that are used at a higher rate than in normal language use. In that case, their lexical retrieval is influenced by grammatical complexity. But there is another possible explanation, which is that the use of finite verbs as such might limit lexical retrieval abilities. This may appear to be a very subtle difference, but it seems rather essential. In the latter case, it is not only grammatical complexity, but also semantic content or 'richness' that influences the use of finite verbs, indicating a real integration problem. On the basis of the present spontaneous speech data, with relatively small numbers of verbs, such a distinction cannot be made; a sophisticated experiment is needed to explore this issue.

Appendix A

Demographics and number of correct items on an action and an object-naming test (60 items each) of the individual fluent aphasic speakers.

<table>
<thead>
<tr>
<th>Gender (m/f)</th>
<th>Age</th>
<th>Months post onset</th>
<th>Action naming</th>
<th>Object naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m</td>
<td>53</td>
<td>25</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>2 f</td>
<td>50</td>
<td>13</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>3 m</td>
<td>55</td>
<td>7</td>
<td>38</td>
<td>51</td>
</tr>
<tr>
<td>4 m</td>
<td>79</td>
<td>15</td>
<td>19</td>
<td>50</td>
</tr>
<tr>
<td>5 m</td>
<td>74</td>
<td>12</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>6 f</td>
<td>74</td>
<td>11</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>7 f</td>
<td>80</td>
<td>37</td>
<td>34</td>
<td>43</td>
</tr>
<tr>
<td>8 f</td>
<td>68</td>
<td>36</td>
<td>45</td>
<td>43</td>
</tr>
</tbody>
</table>

Appendix B

The results of the spontaneous speech analysis of the individual fluent aphasic speakers (1–8) and the mean (range) of the NBD-subjects.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
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<th>3</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<td>0.96</td>
<td>0.95</td>
<td>0.90</td>
<td>0.93</td>
<td>0.98</td>
<td>0.90</td>
<td>0.92</td>
<td>0.96 (0.91–1.00)</td>
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<td>4</td>
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<td>17</td>
<td>21</td>
<td>17</td>
<td>13.4 (9–20)</td>
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<tr>
<td>Verb types</td>
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<td>11</td>
<td>19</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>10</td>
<td>20.5 (17–26)</td>
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<td>Verb tokens</td>
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<td>39</td>
<td>21</td>
<td>23</td>
<td>31.5 (27–34)</td>
</tr>
<tr>
<td>Ttr verbs</td>
<td>0.52</td>
<td>0.67</td>
<td>0.37</td>
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<td>0.55</td>
<td>0.36</td>
<td>0.71</td>
<td>0.43</td>
<td>0.65 (0.56–0.74)</td>
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<tr>
<td>Frequency verbs</td>
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<td>2.37</td>
<td>2.96</td>
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<td>2.85</td>
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<td>6</td>
<td>12</td>
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<td>6</td>
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<td>16</td>
<td>14</td>
<td>20</td>
<td>9</td>
<td>22</td>
<td>12</td>
<td>9</td>
<td>17.6 (10–27)</td>
</tr>
<tr>
<td>Ttr finite verbs</td>
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<td>0.30</td>
<td>0.50</td>
<td>0.44</td>
<td>0.72 (0.56–0.94)</td>
</tr>
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<td>3.16</td>
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<tr>
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<td>12</td>
<td>10</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>10.3 (7–13)</td>
</tr>
<tr>
<td>Non-finite verb tokens</td>
<td>10</td>
<td>21</td>
<td>16</td>
<td>18</td>
<td>13</td>
<td>17</td>
<td>9</td>
<td>14</td>
<td>18.9 (10–17)</td>
</tr>
<tr>
<td>Ttr non-finite verbs</td>
<td>0.80</td>
<td>0.74</td>
<td>0.43</td>
<td>0.67</td>
<td>0.77</td>
<td>0.71</td>
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<td>0.74 (0.50–0.90)</td>
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<tr>
<td>Frequency non-finite verbs</td>
<td>2.64</td>
<td>1.98</td>
<td>2.70</td>
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<td>2.95</td>
<td>2.48</td>
<td>2.40</td>
<td>2.54 (2.00–3.23)</td>
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</table>

References


Please cite this article in press as: Bastiaanse, R., The retrieval and inflection of verbs in the spontaneous speech of fluent aphasic..., Journal of Neurolinguistics (2010), doi:10.1016/j.jneuroling.2010.02.006


