

Aspects of lexical verbs in the spontaneous speech of agrammatic and anomic patients

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1. Introduction¹

Studies on the production of verbs in aphasia are relatively rare. There are some reports about the production of lexical verbs (from now on 'verbs'), mainly concerning action naming compared to object naming in different types of aphasia. Selective disorders both for verbs (McCarthy and Warrington, 1985; Caramazza and Hillis, 1991; Daniele et al., 1994) and for nouns (Zingeser and Berndt, 1988; Daniele et al., 1994) are reported in case studies. Recent group studies focus on the differences between action and object naming on the one hand and between the performance of agrammatic and anomic patients in action naming on the other (Miceli et al., 1984; Williams and Canter, 1987; Basso et al., 1990; Zingeser and Berndt, 1990; Bastiaanse, 1991; Bates et al., 1991). The general tendencies of the outcomes are that agrammatics name objects better than actions and that anomics are better in action naming than agrammatics, but that the results may depend on the kind of task.

Studies on the use of verb constructions in spontaneous speech (in which we include speech elicited through the use of a cartoon strip or the 'cookie theft' picture from the BDAE (Goodglass and Kaplan, 1983), or by letting the patient tell a fairy tale) are even more exceptional. These studies are restricted to the data of agrammatic patients. Miceli et al. (1983) analysed the spontaneous speech of two Italian agrammatic patients and they took the use of the verb into account. Their Case 1 (G.G.) omitted the verb more often than Case 2 (T.F.). Case 2 on the other hand often substituted the inflected form for the infinitive and left out the auxiliary. In their study of spontaneous speech of Dutch aphasic patients Vermeulen and Bastiaanse (1984) showed that anomics produced more and agrammatics fewer auxiliaries than normal controls. In 1985, Lapointe reported on the production of verb forms in agrammatic output, both in spontaneous speech and in a sentence construction task. His conclusion was that agrammatics show a strong tendency to use lessmarked verb forms, *i.e.* infinitive (V), V+s, V+ing, is V+ing (for English). Bastiaanse et al. (1991) showed that these results may be task-dependent (at least for Dutch). Saffran et al. (1989) found more or less the same phenomena as Lapointe (1985). Their quantitative analysis system for

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2 *Roelien Bastiaanse, Roel Jonkers and Uke Moltmaker-Osinga*

agrammatic speech includes the variable *elaboration of auxiliaries*. A patient gains credits for verb inflection, the use of auxiliaries, tense markers and so on. Agrammatics scored significantly lower on this variable than nonagrammatics and normal controls, meaning that the verb forms are less elaborated. They also found that agrammatics inflect the verb significantly less often than nonagrammatics and normal controls. Byng and Black (1989) developed a system for the analysis of verb-argument structures in nonfluent speech. The three agrammatic patients in their study showed difficulties in producing verb-argument structures and four out of six patients showed a tendency to omit obligatory arguments. Lorch (1990) studied several aspects of the verb in the spontaneous speech of agrammatics in three highly inflectional languages. She took two lexical variables into account: the number of verbs and the token-type ratio. The results showed that agrammatics produce an equal amount of or fewer verbs than normal controls and that the variety of the verbs is similar or reduced in agrammatism. Jonkers (1993) focused on the lexical aspects in the spontaneous speech of both agrammatic and anomic (Dutch) patients. Both groups produced fewer verbs than normal controls. The mean word frequency of the verbs was significantly lower for anomics than for normal controls. This difference was not found for the agrammatics. The agrammatics, on the other hand, showed specific problems in the production of complex verb forms (as already suggested by Lapointe, 1985 and Saffran et al., 1989). The anomics omitted the verb significantly more often than normal controls. Goodglass et al. (1993) compared the spontaneous speech of agrammatic and paragrammatic aphasics on several morphological and syntactic variables. For verb production these were: substitution and omission of obligatory auxiliaries and copulas, verbs and verb inflection. They found that agrammatics omitted these items significantly more often than paragrammatics. Paragrammatics tended to substitute these variables more often than agrammatics, but this difference was only significant for the auxiliaries.

In sum, several studies show that agrammatics have particular problems using auxiliaries and verbs in spontaneous speech. In action naming tasks, these patients have problems in finding the verbs belonging to the pictures. Little is known, however, about the use of verbs in spontaneous speech of anomic patients. In the present study, the use of verbs in spontaneous speech of agrammatic and anomic aphasics has been compared to that of normal controls. It should be emphasised that we do not compare verbs with other word classes (*e.g.* nouns or prepositions), nor do we make a comparison between the two patient groups. This study focuses on the question whether the verb production of the two patient types differs from normal verb production and if so, how this deviation may be explained in terms of sentence production. Therefore, various linguistic aspects of the verb have been taken into account.

In the next section, these aspects will be clarified within the framework of Levelt's (1989) sentence production theory. Subsequently, the variables and subjects will be presented, followed by the results of the analysis. Finally, these results will be discussed, with the emphasis on the relation between the results and the various stages of sentence production.

2. Aspects of verbs in relation to sentence production

2.1. Sentence production

Processing of verbs plays a role at all levels of speech production. The correct production of a verb form in a sentence requires grammatical encoding, word-form retrieval, insertion of morphological endings and phonological processing. In figure 1 a graphic representation of sentence production is given, based on the theory of Levelt (1989).

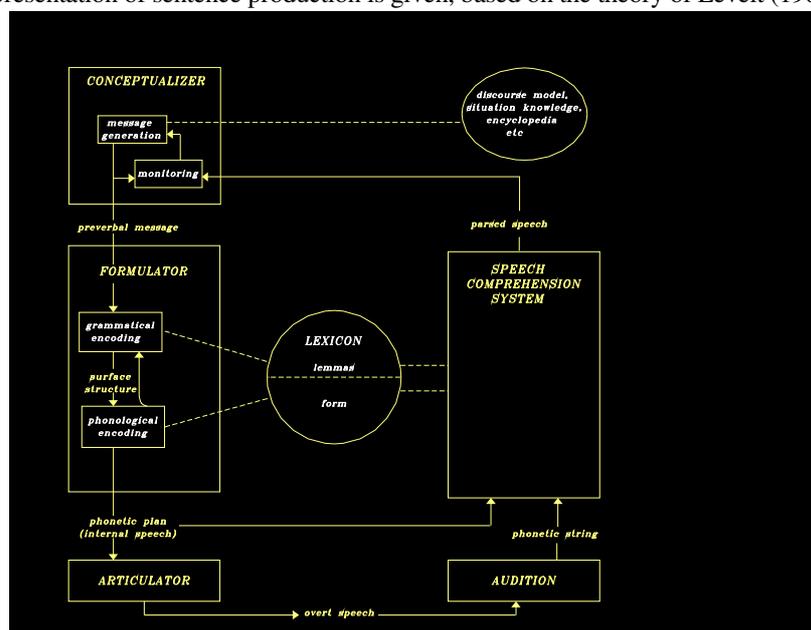


Figure 1: Graphic representation of the various stages involved in sentence production (Levelt, 1989).

Assume that the speaker wants to express a relation between two concepts, for example that the man kisses the woman. This *preverbal message* has a form like (1):

(1) KISS (man_{agent}, woman_{patient})

The *grammatical encoder* consists of procedures for accessing lemmas (in this case KISS). The lemmas contain information about both meaning and syntax (in this case that KISS is a verb taking a subject and a direct object). When a lemma is activated, its syntax becomes available and the semantic roles must be *mapped* onto the syntactic roles, in this example, agent onto the subject role and patient onto the object role. If the sentence is in the passive form (*i.e.* 'the woman is kissed by the man'), the patient role should be mapped onto the subject role and the agent role onto the adjunct. The mapping procedures for the active form result in a structure like (2):

4 Roelien Bastiaanse, Roel Jonkers and Uke Moltmaker-Osinga

(2) KISS (man_{agent,subject}, woman_{patient,object})

The grammatical encoder can now build a surface structure: an ordered string of lemmas grouped in phrases. The word order of this structure is language dependent: in Dutch the subject is usually in first position, the finite verb is in second position etc.

The lemmas are connected with the word forms, which now have to be retrieved from the lexicon and the correct affixes should be assigned. This means that the correct entry /kis/ should be found and the correct inflection /s/ must be added. If the sentence is in the past tense, then the same entry would be addressed, but morphology would require the form /kis+d/. When the correct word form is retrieved and correctly inflected, the string should be processed phonologically (resulting in /T@m&nkisizD@wum@n/) and can then be produced orally.

With respect to the verb, a disorder in grammatical encoding results in the omission of obligatory arguments or mapping errors (the semantic roles are mapped onto the wrong syntactic roles (*e.g. the girl bites the dog*). In the spontaneous speech data of Byng and Black (1989), omission of obligatory arguments frequently occurs in agrammatism, but mapping errors are rare. Grammatical problems may also lead to word-order errors. In Dutch, inversion errors between the subject and the finite verb may occur, as will be described below.

If a lemma fails to activate the word form, this is reflected by problems in retrieving the intended word form from the lexicon, especially when it is a low-frequency word. In this case the patient may either break off the sentence and start anew or use a related word with a higher frequency, which is easier to retrieve.

An impairment to the production of grammatical morphemes will, in the case of verbs, result in the production of verb forms with little elaboration with respect to inflection, auxiliaries etc. and incorrectly inflected verb forms, as suggested by Saffran et al. (1989) and Goodglass et al. (1993). Problems at the stage of phonological processing will lead to phonemic paraphasias and fall beyond the scope of this study.

2.2. The verb in Dutch

Dutch grammar differs from English with regard to the position of the verb in the sentence. In the declarative main clause, the finite verb is invariably in second position, either directly preceded or directly followed by the subject, dependent on whether a topicalised phrase is in first position. This means that inversion is required when topicalisation takes place. Examples are given in (3) and (4).

(3) *main clause*
Hij schrijft een brief
He writes a letter

(4) *main clause, topicalisation*
Gelukkig schrijft hij een brief
Fortunately writes he a letter

If an auxiliary is used, the verb is at the end of the phrase. In a subordinate clause, the verb (whether in finite or in infinite form, *i.e.* whether or not an auxiliary is used) is always in final position. In (5), (6), (7) and (8) some examples are given which may illustrate the differences between Dutch and English.

- (5) *main clause, no auxiliary*
Hij *schrijft* een brief
He *writes* a letter
- (6) *main clause, auxiliary*
Hij heeft een brief *geschreven*
He has a letter *written*
- (7) *main clause, auxiliary, topicalisation*
Gisteren heeft hij een brief *geschreven*
Yesterday has he a letter *written*
- (8) *main clause, auxiliary, + subordinate clause, no auxiliary*
Hij heeft *geschreven* dat hij morgen *komt*
He has *written* that he tomorrow *comes*

In short, the finite verb in the main clause is always in second position and nothing can be placed between the subject and the finite verb. If another constituent is topicalised, subject - finite verb inversion must take place. If an auxiliary is used, the verb is in final position. In subordinate clauses, the verb is always in final position.

Dutch is not a highly inflected language, but it has more inflectional forms for verbs than English. Most infinitives are composed as stem+@n, the form that is also used for the plural forms in the present tense. The first person singular is represented by the stem, the second and third person by stem+t. No progressive (V+ing) is used in Dutch.

3. Expectations

Within the outlined framework and on the basis of the literature, we expect the following. Agrammatics will often omit verbs (Miceli et al., 1983; Lorch, 1990; Goodglass et al., 1993). If the verb is realised, they may omit obligatory arguments (Byng and Black, 1989). They may also have problems with the word order (Saffran et al., 1980), more specifically, obligatory inversion between subject and finite verb will not always be applied correctly. As far as word-form retrieval is concerned, little is known, except that verbs are often omitted. This is not necessarily a reflection of poor lexical access, however. The verbs produced by some agrammatics have for example, the same type-token ratio and the same word frequency as those produced by normal controls (Jonkers, 1993). Lorch (1990), on the other hand, found in some of her

agrammatic patients a high token-type ratio, which she took to imply that these agrammatics showed little variation in their verbs.² Hence, the results reported thus far with respect to a lexicality effect for verbs in agrammatic spontaneous speech are not unanimous. The use of verb inflections is expected to be affected in agrammatics: they will show little morphological elaboration of the verbs in terms of auxiliaries (Lapointe, 1985; Saffran et al., 1989) and will make errors in verb inflection (Miceli et al., 1983; Saffran et al., 1989; Goodglass et al., 1993). In short, agrammatics will show deficiencies at all levels of processing.

For anomics it is less obvious what to expect. Anomic aphasia is characterised by word-finding problems, but some studies showed better verb than noun retrieval for anomics, at least in naming tests (e.g. Miceli et al., 1984). Hence, it is unclear whether anomic aphasics fall short in verb-form retrieval. Jonkers' pilot study (1993) showed, however, that anomics produce fewer verbs than normal controls and that these verbs have a relatively high frequency. The verbs the anomics produced showed less variation than those of normal controls, although this difference failed to reach significance.

4. Methods

4.1. Subjects

For this study, the spontaneous speech of 10 aphasics and 10 normal controls was analysed. The aphasic subjects were selected from a data base of around 200 aphasic patients. The criteria for selection were that a patient *a.* clearly belonged to an aphasia subgroup (agrammatic or anomic) on the basis of spontaneous speech characteristics (judged by a well-experienced clinician) and his performance in the Token Test, *b.* did not suffer from an articulatory disorder which made a large amount of the spontaneous speech incomprehensible, and *c.* had produced sufficient comprehensible spontaneous speech for the method of analysis.

The aphasic subgroup consisted of five agrammatic and five anomic aphasics. The relevant data of the patients are given in table 1. The ten control subjects were taken from the pool used by Vermeulen and Bastiaanse (1984). These are elderly, non-brain-damaged people, especially selected to match an aphasic population.

² In contrast to Jonkers (1993) and the present study, Lorch used a token-type ratio instead of a type-token ratio. A high token-type ratio is comparable to a low type-token ratio.

Table 1: Sex (m=male, f=female), age, time post-onset (tpo, in months) and etiology (cva=cerebro vascular accident, tbi=traumatic brain injury) of the aphasic subjects (agr.=agrammatic, ano.=anomic).

| | | <i>sex</i> | <i>tpo</i> | <i>age</i> | <i>etio</i> |
|-------|---|------------|------------|------------|-------------|
| Agr.1 | m | 43 | 12 | cva | |
| Agr.2 | m | 39 | 252 | tbi | |
| Agr.3 | m | 36 | 9 | cva | |
| Agr.4 | f | 60 | 35 | cva | |
| Agr.5 | f | 42 | 15 | cva | |
| Ano.1 | m | 68 | 4 | cva | |
| Ano.2 | f | 31 | 9 | cva | |
| Ano.3 | f | 63 | 1 | cva | |
| Ano.4 | m | 73 | 1 | cva | |
| Ano.5 | m | 53 | 21 | cva | |

4.2. Procedure

All spontaneous speech samples were recorded on audio or video tape. The subjects had been asked to discuss daily activities, hobbies, former jobs etc. These samples were transcribed in orthographic script and analysed by advanced students of neurolinguistics.

Each sample was divided into 'analysis units', based on the division method of Saffran et al. (1989), with one revision: with each conjunction a new unit starts.³ We chose a grammatical unit for our analysis, and not a fixed amount of minutes or words, since we were interested in a grammatical word class. Since speech rate varies greatly

³ Segmentation into units took place according to the criteria given by Saffran et al. (1989): syntactic criterion: a boundary follows after a syntactically well-formed sentence; prosodic criterion: falling intonation suggests the end of an utterance; pauses. Contrary to Saffran et al., a conjunction was also considered to be a unit boundary. The following were omitted from the analysis: minors (yes, no, etc.); 'starters' which are used habitually; repeated elements: only the final occurrence was analysed; interruptions: only the completed fragment was used; repaired elements: only the repairs were taken into account; elaborated elements: only the elaborations were analysed.

Direct discourse markers, like *he said*, are taken into account in our analysis, contrary to Saffran et al. Incomplete and one-word utterances were interpreted as units.

Some examples of segmentation are:

- (1) *he calls the man who walks on the street*
2 units (he calls the man / who walks on the street)
- (2) *the man who bought the house, walks on the street*
2 units (the man walks on the street / who bought the house)
- (3) *the man who walks on the street*
1 unit

among the two patient groups and since we focused on one grammatical word class, analysis based on time or on the total number of words seemed less suitable. For each subject, 40 units were analysed.

4.3. Methods of analysis

The variables were chosen on the basis of the literature and were meant to cover the three different levels of speech processing: grammatical encoding, retrieval of word forms and the insertion of inflectional morphemes.

First of all, an overall variable was included, *i.e.* the *verb score*. It is defined as 'the number of verbs (including copulas, comparable with Saffran et al., 1989), divided by the number of units of analysis (=40)'.

To assess the patient's abilities to retrieve the word forms from the lexicon, the *type-token* ratio of the verbs was computed: 'the number of different verbs, divided by the total number of verbs'. This variable measures the variety of the verbs produced. A low type-token ratio means that the variety of the produced verbs is low. A low type-token ratio reflects word-finding problems (Vermeulen et al., 1989).

The first variable to reflect the grammatical encoding ability was the *argument index*. This is 'the number of realised arguments of the verb, divided by the number of arguments required'. This index is meant to reflect a patient's ability to produce the obligatory arguments belonging to a verb.

As a second variable on the level of grammatical encoding, the *inversion index* was included. This index is defined as 'the number of instances in which subject - verb order is correct, divided by the number of lexical verbs'. A low index indicates that inversion is not always applied when it is required.

Finally, two variables have been used to evaluate the morphological aspects of verbs, both adopted from Saffran et al. (1989). First, the *inflection index*, which is defined as 'the number of times inflection is correctly realised, divided by the number of times it is required'. Second, the *elaboration of auxiliaries* (henceforth *auxiliary index*), which is computed as follows. For each verb produced, one point is given. Extra points are given for auxiliaries, inflection and past tense. The total number of points is divided by the total number of verbs and one point is subtracted from the total. This variable is meant to reflect how well a patient can construct morphologically complex verb clusters. The inflection index is meant to measure whether the patient is able to use grammatical morphemes correctly, the elaboration of auxiliaries is meant to measure how well a patient can express semantic notions such as aspect, tense, mood etc. by morphological means.

5. Results

5.1. Reliability

As mentioned by Saffran et al. (1989), the reliability of transcriptions is generally quite high and was therefore not tested. To test the reliability of the method of analysis, 14 samples of aphasics (not all of them belonging to the final patient group) and 3 samples of the control group were analysed twice, by different raters. The interjudge reliability appeared to be high and was significant for all variables (r varying from 0.68 for the variable *inversion index* to 0.97 for the *verb score*).

5.2. Results of analysis

The mean scores and standard deviations of the three subject groups are given in table 2. A graphic representation can be found in figures 2a and 2b.

Since the group scores were not normally distributed, Mann-Whitney-U tests were used to test for significance. As can be seen in table 2, both patient groups differ significantly from normal controls on the variable *verb score* (agrammatics: $z=-3.08$, $p=0.002$; anomics: $z=-2.29$, $p=0.022$).

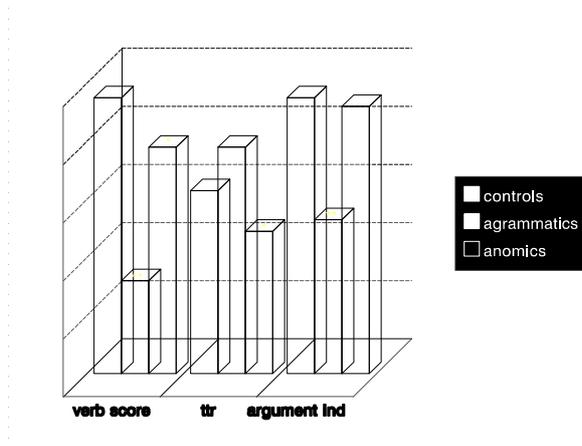
Similar results were reported earlier for the agrammatic aphasics (Miceli et al., 1983; Saffran et al., 1989; Lorch, 1990; Goodglass et al., 1993). Only Jonkers (1993) mentioned that anomics are poor in verb production in spontaneous speech.

Furthermore, the agrammatic aphasics differ significantly from normals on all variables, except for the type-token ratio (type-token ratio $z=-1.53$, $p=0.125$; argument index $z=-3.09$, $p=0.002$; inversion index $z=-3.23$, $p=0.001$; inflection index $z=-3.12$, $p=0.002$; auxiliary index $z=-1.96$, $p=0.050$). Some

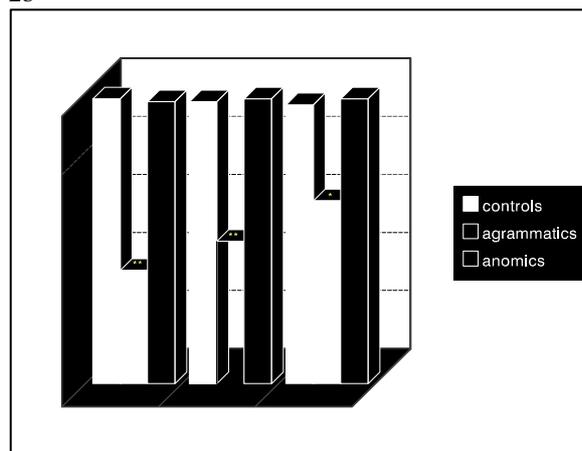
Table 2: Means and standard deviations of the controls compared with the aphasic subgroups (* $p<0.05$, ** $p<0.01$, Mann-Whitney-U tests).

| | controls mean (sd) | agrammatics mean (sd) | anomics mean (sd) |
|------------------|-----------------------|--------------------------|----------------------|
| verb score | 0.95 (0.07)0.32** | (0.14) 0.78* | (0.18) |
| type-token ratio | 0.63 (0.08) 0.78 | (0.18) 0.49* | (0.11) |
| argument index | 0.95 (0.06)0.53** | (0.21) 0.92 | (0.04) |
| inversion index | 0.98 (0.03)0.39** | (0.31) 0.97 | (0.05) |
| inflection index | 0.97 (0.04)0.49** | (0.22) 0.98 | (0.01) |
| auxiliary index | 0.96 (0.21) | 0.63* (0.37) | 0.98 (0.21) |

2a



2b



Figures 2a-b: Graphic representations of mean scores of the controls compared with the aphasic subgroups (* $p < 0.05$, ** $p < 0.01$, Mann-Whitney-U tests). 2a: verb score, type-token ratio and argument index, 2b: inversion index, inflection index and auxiliary index.

Examples of the errors the agrammatics produced are given in (9) for illustration:

- (9) Schiet mij niet gauw te binnen (argument structure error)
Doesn't soon occur to me
- Waren we in hotel (inversion error)
Were we in hotel

Ik hoor altijd wat ik zegt (inflection error)
I hear always what I says

The anomic aphasics produce, as mentioned before, fewer verbs than normal controls and the verbs they do produce show significantly less variability than those of normal controls (type-token ratio: $z=-2.51$, $p=0.012$). They do not differ from the normal controls on other variables.

6. Discussion

The analysis showed that both patient groups produce fewer verbs than normal subjects. Agrammatic aphasics further deviate from normal controls on all variables, except the type-token ratio. This contrary to anomic aphasics, who only fall short on this variable. In this section, we will discuss these results in relation to Levelt's (1989) theory about sentence production, mentioned in section 2.1., and the relevant literature.

First of all, we consider the agrammatics' performance. We expected them to show deficiencies at all levels. The type-token ratio is normal, however. This holds for all our agrammatics, but two of Lorch's (1990) agrammatic patients showed little variability in the produced verbs. It should be noticed, however, that the mean number of verbs used by the agrammatics in our study is 13, compared to 31 of the anomics. One of the subjects produced only 4 verbs. Hence, from the fact that the type-token ratio is normal, we cannot conclude that word finding is normal in the agrammatics: some agrammatics hardly produce any verbs in spontaneous speech.

The fact that the agrammatics fall short at both other levels, grammatical encoding and morphological insertion, raises the question whether this is a reflection of one underlying disorder, showing at each level, or that both levels are impaired.

There is still a debate about whether agrammatism is a unitary syndrome or a collective notion for different syndromes. Some authors assume that there are at least two types of agrammatism, *i.e.* a morphologically- and a syntactically-based agrammatism (*e.g.* Saffran et al., 1989; Caramazza and Hillis, 1989; Miceli et al., 1989). This conception is disputed by others, who claim that the differences found are a reflection of the same underlying disorder (Caplan, 1991; Grodzinsky, 1991; Tesak, 1992; Bastiaanse, 1993, 1995). Is it then possible, that the deficiencies found at both levels are due to one underlying disorder?

It is clear from the data that agrammatics have more problems than anomics in producing verbs in spontaneous speech. Previous research showed that this is not only the case in spontaneous speech, but also in a naming task (*e.g.* Miceli et al., 1984; Zingeser and Berndt, 1990). Why are verbs difficult to process for agrammatics? Lemmas of verbs do not only contain information about their core meaning, but also about the argument structure, the subcategorisation frame etc. During grammatical encoding, all this information has to be retrieved and processed in order to build the sentence representation. It seems as though this level of processing is impaired in agrammatism. This explains why agrammatics often omit the verb. When they do use a verb, they leave out obligatory arguments (which leads to a low argument index), do

not apply inversion (because they often omit the external argument which should have been mapped to the subject role, see Byng and Black, 1989), they neither specify time, aspect etc. with the help of auxiliaries, nor inflect the verb.

Although we suggest that the problems agrammatics have in the production of verbs arise at the level of grammatical encoding, we do not assume that the a problem in processing verbs as such is the underlying deficit in agrammatism. Agrammatic patients surely have more problems which can cause telegraphic speech. That there exists no causal relation between agrammatism and problems in verb processing, has recently been shown by Daniele et al. (1994): two of their patients (suffering from primary progressive aphasia) had a category-specific deficit for verbs, but they did not speak agrammatically. Bastiaanse (1995) on the other hand, presented a case study of an agrammatic patient without action naming difficulties.

Anomics produce *fewer verbs* with a *lower type-token ratio* than normal controls. The low type-token ratio was expected, since anomic aphasia is characterised by word-finding problems and empty speech. This is in line with the results of Vermeulen and Bastiaanse (1984): they found a low type-token ratio for the variable *content words*, which included verbs. But how can we explain the reduced number of verbs without consequences for the other variables?

The anomics produce fewer verbs due to their word-finding problems. It seems as though they use a strategy, which is applicable to Dutch, but not to English. They start a sentence with a subject or with a topicalised constituent, they then produce an auxiliary, subsequently the other constituent(s) and finally, when they have to produce the verb, they break off the sentence: the verb is omitted (for example *eerst dan gaan we ... eh: `first then go we ... er'*). This means that these patients postpone the production of the verb by using an auxiliary. When they finally have to realise the verb, they fail to do so and break off the sentence instead. Unfortunately, units without a verb were not analysed with respect to the use of auxiliaries. We therefore do not know exactly, how often this phenomenon occurred. It has been found before, however, that (Dutch) anomics produce significantly more auxiliaries than normal controls (Vermeulen and Bastiaanse, 1984). It seems as though Dutch anomics produce more auxiliaries and fewer verbs than normal controls in their spontaneous speech by applying a strategy to evade their retrieval deficit. A similar strategy will not be effective in English. Crosslinguistic research is needed to find out whether anomics who are native speakers of an SVO-language encounter the same problems with verbs and if so, how they deal with them.

7. Conclusions

As mentioned in the introduction, little is known about verb production of aphasics in spontaneous speech, and the research that has been done has focused on agrammatism. The present study showed that agrammatics are not the only aphasics who show a deficiency in verb production. To summarise, we saw that both agrammatics and anomics produced fewer verbs in spontaneous speech than normal controls.

Agrammatics differed from normal controls on all other variables, save the type-token ratio. We suggested that the different deviations with respect to verb production can be explained by assuming one underlying disorder, *i.e.* a deficiency in grammatical encoding, more specifically, a deficiency in retrieving and encoding the complete lemma information of the verb from the lexicon.

The verbs produced by anomic patients showed little variability. The anomics produced significantly fewer verbs in their spontaneous speech than normal controls. It has been suggested that these patients apply a strategy: by using an auxiliary they can postpone the selection of the verb to the end of the sentence, at which point they often break off the utterance.

This study raised many questions which cannot be answered by spontaneous speech analysis alone. Suggestions, but no proofs have been given for the underlying disorders. Further research is needed, *e.g.* comparison between verb production in spontaneous speech and on sophisticated tests on the one hand, and between verb and noun production in spontaneous speech on the other. We hope we have given an incentive for further research on this topic.

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14 Roelien Bastiaanse, Roel Jonkers and Uke Moltmaker-Osinga

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