

Broca's Aphasia: A Syntactic and/or a Morphological Disorder? A Case Study

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The patient described here suffers from Broca's aphasia without a comprehension disorder. She is unique, since she has two speech styles available and she shifts between them spontaneously. One style is characterized by a mild syntactic disorder and the other by a quite severe morphological and syntactic disorder. None of the current theories about the underlying disorder in Broca patients without comprehension deficits can account for the fact that two linguistically different speech styles can occur in one patient, except the adaptation theory. It will be argued that both styles can be explained by the assumption of an impairment to the *grammatical encoder* (a processor which transforms the preverbal message into a surface structure, Levelt, 1989). This view suggests that the distinction between syntactic and morphological agrammatism could be a matter of strategy, rather than of impairment. © 1995 Academic Press, Inc.

INTRODUCTION

In this article, a patient suffering from Broca's aphasia is described. In all tests on oral language processing she performed perfectly. In spontaneous speech, however, her aphasic problems emerge. Remarkably, the patient has two speech styles available, which can be defined as *non-telegraphic* and *telegraphic*, and she shifts from the first to the second spontaneously. As far as is known such a phenomenon has not been described before.

In the Introduction, the following topics will be under discussion: terminology, Levelt's speech production model (Levelt, 1989), case studies

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of patients who, as the one described here, suffer from Broca's aphasia without comprehension disorders, and the adaptation theory. Next, the patient is described and the results of the linguistic examination are presented. Under Discussion, it is shown that only the adaptation theory can account for the data. What this means in terms of linguistic processing will be explained with the help of the speech production model of Levelt (1989).

Terminology

Apart from *Broca's aphasia* the term *agrammatism* is often used to refer to the syndrome. Caramazza and Berndt (1985) define agrammatism as "a speech output characterized by the omission of grammatical morphemes, reduced phrase length, the omission or nominalisation of verbs, and difficulties with word order" (Caramazza & Berndt, 1985, p. 33).

Saffran, Berndt, and Schwartz (1989) distinguish two types of Broca patients, *i.e.*, agrammatic and nonagrammatic. The similarity between these types is their sparse halted speech, combined with good auditory comprehension. The agrammatic patients frequently omit at least some bound and free-standing grammatical morphemes and the output is non-fluent. Two nonagrammatic patients produce a relatively full complement of grammatical morphemes, but their output is nonfluent as well. This means that some aphasiologists suggest that Broca's aphasics do not necessarily have to produce telegraphic speech.

Here the terms "telegraphic speech" and "non-telegraphic speech" will be used instead of 'agrammatic' and 'nonagrammatic', since the term 'telegraphic speech' refers to a symptom and the term 'agrammatism' usually refers to a syndrome, *i.e.* Broca's aphasia, with implicit statements about language comprehension.

Levelt's Speech Production Model

In Fig. 1, Levelt's model for speech production is depicted (Levelt, 1989). Here only a short description is given, illustrated by an example.

Assume that one wants to produce the sentence *the man kisses the woman*. The *conceptualizer* sends a preverbal message to the *formulator*. In the formulator the *grammatical encoder* retrieves the lemmas from the lexicon. It consists of procedures for accessing lemmas and syntactic building procedures. The lemmas contain word-class information, *e.g.*, that *kiss* is a verb and *man* is a noun. The lemmas also contain information about meaning, *e.g.*, that *man* is animate and that *kiss* needs a subject and may have an object. After the phrase *the man* is processed, the concept *KISS* must be grammatically encoded. The concept *KISS* contains the information that person (*X*), the actor, does something to person (*Y*), the patient. The grammatical encoder retrieves the lemma *kiss* from

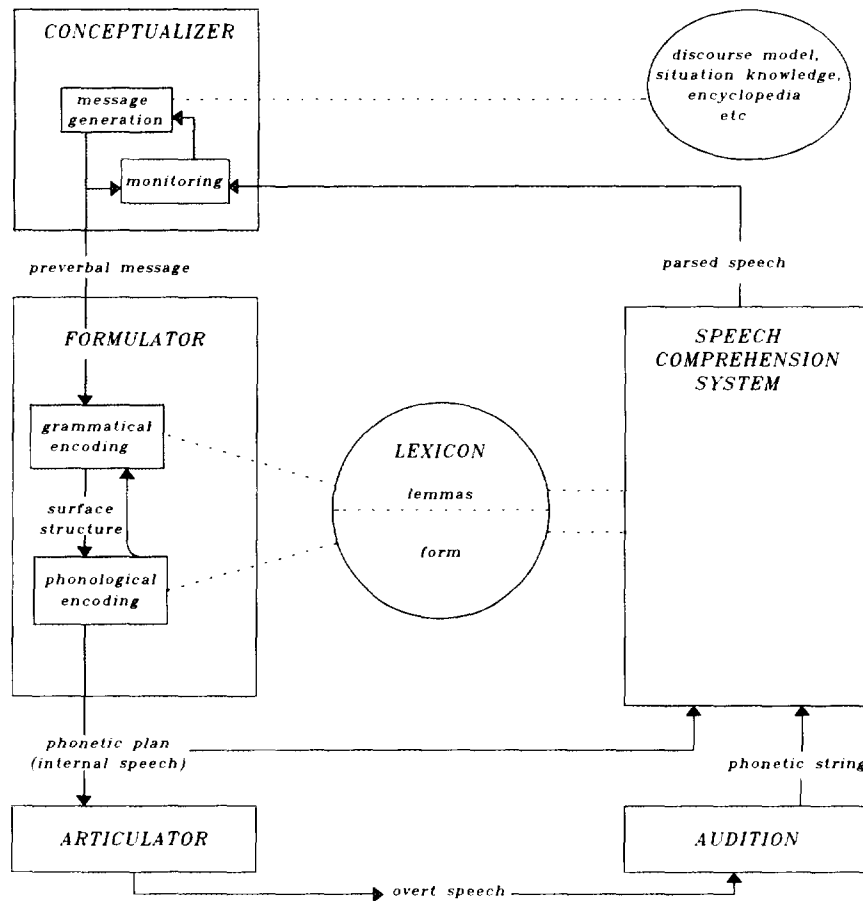


FIG. 1. Levelt's blueprint for a speaker (Levelt, 1989, p. 9).

the lexicon. The syntactic lemma information is used to build the surface structure of the sentence. In this example, the syntactic lemma information is that *kiss* is a verb needing a subject and a direct object. The syntactic roles must be mapped onto the semantic roles, in this case actor → subject, patient → object, resulting in the surface structure $MAN_{\text{subject,actor}} \text{ KISS}_{\text{verb}} \text{ WOMAN}_{\text{object,patient}}$. When the intended sentence *the woman is kissed by the man* is to be produced, and the actor should be mapped into the oblique case role and the patient in the subject role.¹

¹ Whether a sentence is produced in active or passive voice is dependent on the preverbal message. In the preverbal message, the topic is highlighted and during grammatical encoding it will be put in a prominent position, meaning that it will be encoded as grammatical subject.

The activated lemmas trigger the corresponding forms. These forms are used to encode the surface structure phonologically. When the correct form is retrieved from the lexicon, it must be processed by the *phonological encoder*. This processor contains the information about the phonological rules of the language. One of the most important things to be done here is the computation of the syllabification of words (see Levelt, 1993a).

The grammatical word-forms are also stored in the form-part of the lexicon. This means that when the verb is encoded for the third person singular in the perfect tense, *kiss* should be phonologically encoded as *has kissed*.

When the correct phonemic forms are generated, articulation is planned and executed and the words are pronounced. The output can be monitored by both internal and overt speech, which are processed by the *speech-comprehension system* (see Levelt, 1993b).

Other Case Studies

In this section a brief summary—in chronological order—of recent case studies which are relevant in the light of the patient described below is given. Only case studies comparable to the one presented in this chapter are mentioned, *i.e.*, Broca's aphasics who do not show a comprehension disorder and produce sufficient spontaneous speech for analysis.

Miceli, Mazzucchi, Menn, and Goodglass (1983) describe two agrammatic Italian aphasics. Both patients show the characteristics of agrammatism in spontaneous speech: omission of articles, omission of prepositions, and use of infinitives for finite verb forms. Case 1's utterances are largely composed of disjoint sequences of phrases, in which the main verb is omitted from about one-fifth of his clauses. Case 2, however, hardly ever omits main verbs, but he presents two to three times more omissions of articles and prepositions and substitutions of the infinitives for the inflected verb forms than Case 1. Apart from this, the use of the clitic pronoun system and auxiliaries is severely impaired in this patient. Miceli et al. (1983) argue that omission of clitic pronouns (in Italian) and auxiliary verbs reflects a morphological disorder.² From these findings Miceli et al. (1983) conclude that Case 1 has a moderate syntactic disorder and a mild morphological disorder, whereas Case 2 has an almost pure morphological disorder, thus implying that (Italian) agrammatism appears to be dissociable along two axes: syntax and morphology.

Nespoulous, Dordain, Perron, Ska, Bub, Caplan, Mehler, and Lecours (1988) describe a French agrammatic patient (Clermont) who produces

² Miceli et al. (1983, p. 76) state that "the assignment of these indices to either 'morphological' or 'syntactic' is justifiable under a number of different linguistic theories," without mentioning one.

telegraphic speech in narrative tasks, in which closed-class words are omitted and sometimes substituted and almost no adjectives or complex verb forms are produced. In a way, the same phenomena appear in repetition and oral reading of sentences and in a story completion test. Clermont is, nevertheless, perfectly able to judge the grammaticality of sentences and to perform a sentence anagram task. Nespoulous et al. (1988) argue that the undisturbed performance on the grammaticality judgement and sentence anagram task in combination with the error pattern in the other tasks can only be explained by a reduced processing capacity. They do not explain which process is actually impaired.

Caramazza and Hillis (1989) describe an English-speaking Broca patient, whose sentence production is characterized by omissions and occasional substitutions of both free-standing and bound grammatical morphemes. Just as Clermont, she is able to judge the grammaticality of sentences. She is, however, unable to perform a sentence anagram task. The authors explain her performance by assuming a disturbance on the Positional Level of Garrett's speech production model (1982),³ since the closed-class items are only specified at the Positional Level of sentence representation. "Thus, damage to the mechanisms that generate or control Positional Level representations should result in impaired production of both free-standing and bound grammatical morphemes in all sentence production tasks, independently of modality of output" (Caramazza & Hillis, 1989, p. 640).

An early case study of a Broca patient without a comprehension deficit was presented by Kolk, Van Grunsven, and Keyser (1985). This was the first article in which the adaptation theory was mentioned. They presented a patient who produces telegraphic speech during an interview, but who is perfectly able to produce inflections and function words in a test, when she is forced to use them.

The Adaptation Theory

This alternative theory of Broca's aphasia, although not incompatible with other theories, states that the patient adapts to the actual disturbance by producing telegraphic speech. The idea of adaptation is not new: it was Isserlin (1922) who introduced this economy hypothesis. Isserlin was not taken seriously, however, and was subsequently forgotten until in the early eighties when Kolk rescued his ideas from oblivion. Kolk states that in order to explain agrammatism, one should not consider the symptoms of telegraphic speech, but the disorder causing telegraphic speech.

³ At the Positional Level as proposed by Garrett (1982), the surface structure of the to-be-produced sentence is specified. This representation determines the selection of phonological representations from the lexical system.

The symptoms are only the results of a strategy, which he refers to as the "adaptation strategy" (Kolk et al., 1985; Kolk & Heeschen, 1990). In short, Kolk argues that Broca's aphasia manifests itself in telegraphic speech when the patient adapts to his disorder. The real disorder, however, is not a linguistic one, but a more general, neuropsychological one: the cortical area that is most suitable for processing sentence structures has been destroyed by a lesion. In such a case another, less suitable part of the cortex takes over, but this causes a marked delay in processing. The traces of the planned sentence decay and the automaticity of speech production are affected. These effects are only slight when a single word has to be produced, but when a word depends on other words in the sentence, the effect will be more prominent. To cope with this, the patient will adapt to his disorder and simply use another "register," *i.e.*, the register of telegraphic speech, in which the amount of information to be processed is less than when syntactically well-formed sentences have to be produced, because fewer words and less syntactic information have to be kept in working memory. This register is also used by normal speakers, for example, while talking to foreigners (*foreigner talk*).⁴ This adaptation theory is supported by the observation that Broca patients are often able to produce complete sentences, although usually at the expense of much effort and time. The question is: do all Broca patients adapt, or are some Broca patients not recognized as such, because their speech is not telegraphic and therefore not meeting the characteristics of Broca's aphasia? According to Kolk and Heeschen (1990), such Broca patients do exist. The authors suggest that "to discover the nature of the underlying impairment one should not study the agrammatic patient's spontaneous speech as is typically done (...) but their elicited (paragrammatic) speech" (Kolk & Heeschen, 1990, p. 225).⁵ The study of telegraphic speech alone only focuses on what the patient is still able to do, not on what the disorder is.

Summarizing, the opinions about the underlying disorder of Broca's aphasia differ. Miceli et al. (1983) argue that both a morphological and a syntactic disorder can cause agrammatic output; Nespoulous et al. (1988) maintain that a (not further specified) processing disturbance is responsible for the telegraphic output of their patient. Caramazza and Hillis (1989) impute the phenomena in their patient to underspecified representations

⁴ Tesak and Dittmann (1991) have demonstrated however, that only 10 to 20% of agrammatic's utterances were comparable to telegraphic utterances in normals. They conclude from these data that the "telegraphic register" in normals does not seem to be the main guiding principle of telegraphic sentence generation in Broca aphasics.

⁵ In "paragrammatism," the elements (especially the inflected forms and function words) in a sentence are selected incorrectly, sentence elements are omitted, and constructional errors are made, according to Kolk and Heeschen (1990).

at the Positional Level and Kolk and co-workers suggest that telegraphic speech must be seen as adaptation to delayed sentence processing.

There now follows a discussion of a Dutch Broca patient who does not suffer from comprehension disorders. In spontaneous speech, she shows the availability of two different registers, as Kolk and co-workers suggest. Her data will be used to try to bridge the gap between the different views on the underlying disturbance in Broca's aphasia. In the discussion, it will be argued that the explanations of agrammatism, as given by Miceli et al. (1983), Nespoulos et al. (1988), Caramazza and Hillis (1989), and Kolk and Heeschen (1990), are not as diverse as they seem.

CASE HISTORY

The patient discussed is a right-handed woman who became aphasic at the age of 41. She is a native speaker of Dutch. Mrs. HW is married and has two children, a 15-year-old son and a 12-year-old daughter. Until the stroke she was a cleaning woman two mornings a week and a so-called "reading mother" at the primary school. Her hobbies were needlework, reading, and fishing. HW was healthy but suffered from a hearing impairment on the left side.⁶

One morning in August, 1986, she was suddenly paralyzed on the right side and aphasic and was hospitalized in an unconscious state. When she came conscious again she was unable to speak, her right limbs were paralyzed and her vision was hazy. Two weeks post-onset a CT-scan was made, revealing an ischemic infarct in parts of the temporal and parts of the frontal lobe, with extension to the parietal lobe in the left hemisphere.

One month post-onset HW was dismissed from the hospital and admitted into the rehabilitation center as an inpatient. At that moment the right arm was still not functional. The paresis of the right leg had decreased and she was able to walk with a delta-stick.

She was linguistically and neuropsychologically screened by the aphasia team of the rehabilitation center 4 months post-onset. The linguistic screening revealed that HW suffered from a typical Broca's aphasia, in which comprehension of spoken language was relatively intact (score on the Token Test was 56 out of 61). The neuropsychological assessment showed a weak verbal memory (percentile score of 50 compared to aphasics) due to retrieval deficiencies. On the Raven Coloured Progressive Matrices HW scored in the 7th decile, compared to other aphasics. No other neuropsychological disturbances were found.

HW has been treated five times a week by a speech therapist, both to improve her language abilities and to help HW and her family to cope with

⁶ The exact loss of decibels was unknown. According to the aurist, the perception deficiency in the left ear was severe.

the consequences of her aphasia. The linguistic part of therapy aimed at sentence construction, writing, and text comprehension. The main program used was *The Visual Cue Program* (Van de Sandt, 1986), a program for training sentence construction. Apart from speech therapy, HW received physiotherapy, occupational therapy, and help from a social worker.

Fifteen months post-onset a linguistic assessment was performed to evaluate the effects of speech therapy. This assessment was extended in order to reveal more about the remaining underlying disorder. It was performed in three 2-hr sessions, once a week, during 3 subsequent weeks. All sessions were videotaped. Here only the results in oral language processing are discussed. Performance in the reading and writing tests is discussed elsewhere (Bastiaanse, 1993).

At the moment of the assessment described below, HW was treated as an outpatient. Neuropsychological retesting just before the linguistic assessment revealed a percentile score of 100 of the verbal memory test and a score comparable to an IQ of 110 on the Raven Standard matrix.

RESULTS

Auditory Comprehension of Words

Since auditory comprehension of nouns was intact at previous examination, this was not examined again. Auditory comprehension of verbs was examined with the experimental test of Van de Sandt (unpublished). In this test, the patient has to match one out of four action pictures to a spoken stimulus. One picture is correct, the distractors are semantically related. HW answers all items correctly and without self-corrections.

Auditory Comprehension of Sentences

Auditory comprehension of sentences has been tested with a Dutch version of the Test for Reception of Grammar (T.R.O.G., Bishop, 1982). In this test, originally developed for assessing child language, the comprehension of specific morphological and syntactic structures is systematically examined in blocks of four items ordered to increasing complexity. The first blocks concern simple subject-verb sentences or adjective-noun phrases and sentences with negations; the last block concerns embedded sentences. HW made one error in the single-plural distinction of nouns and one in an embedded sentence. This score (60 out of 62 correct) indicates that sentence comprehension is intact.

Comprehension of spoken complex sentences is intact: on a 30-items version of the Token Test, HW scored 28 correct, which is around the cut-off point.

Spontaneous Speech

In spontaneous speech (elicited by an interview about her speech problems, plans for holidays, and her new house, see Appendix 1), an interesting thing happened. In the first part when HW talks about her speech problems, her performance is quite different from the second part. In the first part almost no telegraphic speech is produced, although the speech is slightly ungrammatical: some syntactic and morphological errors are made. Then, suddenly and unexpectedly, HW starts to produce telegraphic speech: verbs and copulas are omitted, no subject is produced and verbs are non-finite *etcetera*. All these phenomena add up to one single criterion: omission of finiteness, a criterion to distinguish elliptical from non-elliptical utterances (Kolk & Heeschen, 1992). These sudden finiteness omissions were reason to draw the boundary at this point in the interview. After this boundary, mainly elliptical utterances were produced. The reason for this change of style is unknown. Speech rate was delayed in both parts: in the first part 41 words and in the second part 34.7 words per minute (controls produce 138.6 words/min, SD = 42.49, Vermeulen & Bastiaanse, 1984).

The first part (until utterance 18) is compared to an equal number of words in the second part (until utterance 55) and Saffran et al.'s (1989) method of analysis is applied. They have developed a procedure for the quantitative assessment of narrative speech which yields measures for both morphological and structural characteristics. Several variables are counted in a fixed number of narrative words (elicited by asking the patients and normal controls to tell a fairy tale or an other well-known story). The variables are exclusively described in the appendix of the original paper. Here, only a short characterization is given.

Speech rate is the number of words per minute. The following variables are supposed to represent morphological characteristics: *proportion of closed-class words* (the number of closed-class words divided by the number of narrative words), *noun/pronoun ratio* (number of nouns divided by the number of pronouns), *frequency of verb inflection* (numbers of inflectable verbs which are inflected divided by the total number of inflectable verbs), *determiner/noun ratio* (number of nouns which require a determiner and have a determiner divided by the number of nouns which require a determiner), *noun/verb ratio* (number of nouns divided by the number of verbs) and *elaboration index* (the number of main verbs in matrix sentences divided by the AUX-score,⁷ minus 1). The structural variables are: *proportion of words in sentences*⁸ (number of words in sentences divided by the number of narrative words), *proportion of sentences well-formed* (number of well-formed sentences divided by the number of sentences), *structural elaboration of*

⁷ For each auxiliary one point is given and several more points can be gained by negation, tense markers and so on.

⁸ The following utterances are considered to be sentences: *noun + main verb*, *noun + copula + adjective* and *noun + copula + prepositional phrase*.

sentences (number of words in subject NPs divided by the number of subject NPs minus 1, plus the number of words in VPs divided by the number of VPs minus 1) and the *embedded index* (the number of embeddings divided by the number of sentences).⁹

As an interview about speech problems and daily activities is probably not comparable to telling a fairy tale and Dutch is quite different from English, five spontaneous speech samples of healthy Dutch speakers have been analyzed as well. HW's data have been compared to those of the Dutch speakers and not to Saffran et al.'s controls.¹⁰

Saffran et al. use a corpus of 150 narrative words for their analyses. Since HW produces only 90 narrative words in the first part of her spontaneous speech, equal corpora have been used for analysis of the other part of spontaneous speech and the spontaneous speech of the control subjects. The narrative words have been counted and divided into utterances according to Saffran et al.'s prescription. Subsequently, scoring and the production analysis were performed. The results are given in Table 1 and graphically represented in Figs. 2 and 3 (the raw data are given in Appendix 2).

The difference between HW's first and second part is clear from comparison. Both parts differ from those of the normal controls in speech rate. These differences are almost significant (part 1: $t = 2.09$, $p < .10$; part 2: $t = 2.23$, $p < .10$). The first part differs significantly from the control samples on only one morphological and two structural variables (determiner/noun ratio, proportion of words in sentences and proportion of well-formed sentences). A look at the raw scores of the determiners (see Appendix 2) reveals that the significant difference between the first sample and the control samples is due to the fact that in the first sample only two determiners are required, one of which is realised. The real difference between HW's first part and the control samples seems to be the number of determiners which is *required*, not the number omitted. For this reason the difference in this variable will be ignored further. In HW's second part however, the difference from the normal samples seems to be caused by the *omission* of determiners (a determiner is required in 22 instances, whereas only 8 are produced).

⁹ Saffran et al. (1989) do not justify why certain variables are assumed to represent morphological ability and others structural ability. The only remark made is that "the development of the analysis scheme was guided by linguistic considerations, hence, most of the measures bear a direct relationship to linguistic and psycholinguistic units" (Saffran et al., 1989, p. 466). It is clear, however, that the variables concerning free-standing and bound morphemes are called "morphological," whereas the variables concerning sentence construction are called "structural."

¹⁰ It has been confirmed that there is a difference between speech production in an interview and in fairy tales. Since both HW and the controls are talking about themselves, they produce a considerable number of the personal pronouns *I* and *we* as the subject. Consequently the mean Subject NP length is 1, both for controls and for HW.

TABLE 1
Results of Spontaneous Speech Analysis According to
the Method of Saffran et al. (1989)

| Variables | Normals | | HW | |
|-----------------------------|---------|-------|--------|----------|
| | Mean | SD | Part 1 | Part 2 |
| Speech rate | 138.6 | 42.49 | 41.0 | 34.7 |
| Morphology | | | | |
| Prop. closed-class words | .616 | .032 | .561 | .319** |
| Noun/pronoun ratio | 1.257 | .669 | .786 | 11.250** |
| Verb inflection | .877 | .059 | .938 | .500** |
| Determiner/noun ratio | 1.000 | — | .500** | .368** |
| Noun/verb ratio | .695 | .399 | .550 | 5.625** |
| Elaboration of AUX | .927 | .134 | .867 | .571 |
| Structure | | | | |
| Prop. words in sentences | .828 | .047 | .683* | .149** |
| Prop. well-formed sentences | .923 | .077 | .300** | .500** |
| Elaboration of sentences | 1.144 | .633 | 1.180 | 1.000 |
| Embedding index | .163 | .210 | .300 | .000 |

* $p < .05$, ** $p < .01$ (two-tailed t tests, $df = 4$).

The second part differs significantly from the control samples in all but three variables (elaboration of AUX, structural elaboration of sentences, and embedded index). The lack of significance between both parts of HW's spontaneous speech and the samples of the normal controls in the structural elaboration of sentences can be explained by the fact that both HW (in both parts) and the normal controls produce only subject NPs

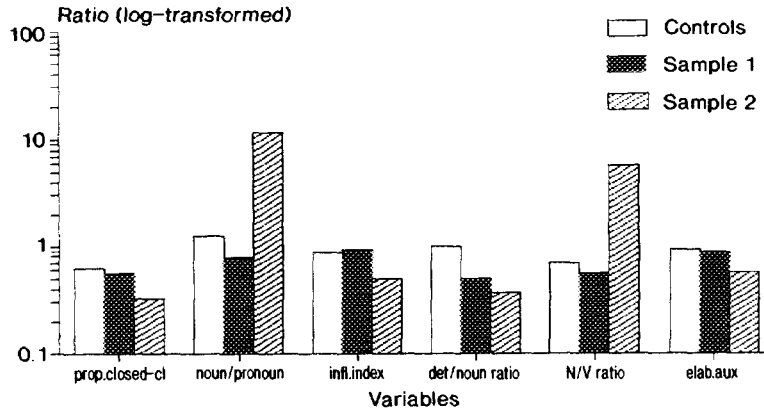


FIG. 2. Results of the spontaneous speech analysis (morphological variables). For reasons of clarity, the ratios are log-transformed.

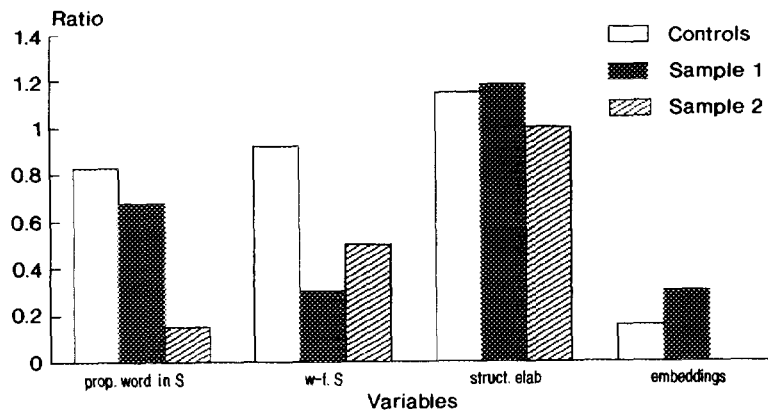


FIG. 3. Results of the spontaneous speech analysis (structural variables).

consisting of one word. The lack of significance between the embedded indices can be explained by the fact that normal controls hardly produce embedded structures. Both HW's parts fall within the normal range, although she does not produce a single embedded structure in the second part.

The main differences between HW's first part and the control samples are the proportions of words in sentences and well-formed sentences. Therefore, these variables are further analyzed in both parts of HW's spontaneous speech. In the first part HW produces the same number of sentences as the controls (see Footnote 8 for Saffran et al.'s definition of a sentence). HW's sentences, however, are significantly shorter and more often ill-formed compared to those of normal controls. Further analysis reveals that the lack of proper formation is due to the use of incomplete or incorrect verb-argument structures (for example: (10) *ik schrijf op*: I write down: object deletion; (11) *niks herinnert mij*: nothing remembers me: subject-object inversion).

In the second part HW produces hardly any sentences, but uses mainly topic-comment constructions in which the main verb or the copula is omitted (for example: (21) *mij portemonnee altijd leeg*: me purse always empty; (24) *in de pan lekkers*: in the pan tasty things). In other utterances, no subject is produced and the lexical verb is non-finite (for example: (26) *lekkers eten*: eat tasty things; (28) *lootjes trekken*: draw numbers). In still other utterances a subject, lexical verb, and object are produced, but the verb is in the final position, probably indicating that it is not conjugated (for example: (29) *allemaal cadeautjes halen*: all gets presents; (34) *we centen sparen*: we saving pennies.)¹¹

¹¹ In Dutch the plural verb forms in the present tense are similar to the infinitive. Hence, it is not certain that these forms are infinitives. In Dutch, however, the finite verbs must

All in all, HW produces four sentences in the second part, two of which are well formed. This means that the difference between HW's first part and the control samples concerns the use of the verb-argument structures. Since HW produces incomplete or incorrect verb-argument structures, her sentences are not well formed, which is expressed in the significant differences between HW and the controls in the variables "proportion of words in sentences" and "proportion of sentences well formed." In the second part, the verb is a source of problems again: it is often omitted or not inflected for tense and aspect.

According to Saffran et al.'s method, the first part is structurally disturbed (significant differences in proportion of well-formed sentences and proportion of words in sentences) and the second part is severely structurally and morphologically disturbed. This means that in the first part the spontaneous speech is ungrammatical but not telegraphic, while the second part is an outstanding example of telegraphic speech.

Naming of Objects and Actions

The Dutch version of the Boston Naming Test (B.N.T., Kaplan, Goodglass, & Weintraub, 1983) was used and all 40 items were named correctly, without hesitation. Therefore, the Graded Naming Test (G.N.T., McKenna & Warrington, 1983) was presented to assess HW's retrieval ability of low-frequency words. Fifteen of 30 items are named correctly, which is about the score of normal controls. The errors concern circumlocutions (mainly of objects whose name she probably never knew, as *pagoda* and *centaur*) or a wrong interpretation of the picture, as *soldaat van vroeger: soldier in former days* for *yashmak* (for which no Dutch word exists) and *fluitje (whistle)* for *retort*.

Naming of actions was administered with the experimental test of Van de Sandt (unpublished), as this is the only Dutch test on this subject. A black-and-white drawing is presented to the patient who is asked to tell in one sentence what is in the picture. The items are relatively simple (for example *to walk, to ski, to paint*). Normal controls score 37/40 or higher in this test; the performance of Broca patients is variable. Some Broca patients perform similar in this test and in the B.N.T., whereas others show more problems for naming actions than nouns (Van de Sandt, personal communication). HW uses the infinitive form of the verb to name the actions. She names 37 items correctly. The 3 verbs she cannot retrieve are described: *de spijker in de lat slaan (to strike the nail into*

be in the second position in the matrix sentence, whereas the infinitive following a modal etc. is in the final sentence position. This is the reason to assume that the forms in the examples are infinitives and not plural finite forms.

the plank) for *timmeren* (to carpenter), *de boot aan de haak hangen* (to hang the boat on the hook) for *aanleggen* (to moor) and *de man poldert, de man schopt het land uit, schopt kuiltje* (the man polders, the man shovels out the land, shovels hole) for *spitten* (to dig).

Sentence Construction

To test the ability to construct sentences the subtest of the Aachen Aphasia Test (Graetz, De Bleser, & Willmes, 1992) was used. The items and HW's reactions are mentioned in Appendix 3. Although HW finally constructed 9 out of 10 sentences correctly, there is a large number of repetitions. These repetitions concern the subject NPs. Two article omissions appear (s. 7 *politieagent*: policeman and s. 9 *woord*: word), one of which was corrected. In the last sentence it seems as though HW wants to make a verb cluster: after *de man ligt op de bank te ...* (the man is lying on the couch to ...) a verb should follow, but instead HW begins a new sentence. In fact, she uses three sentences to describe the picture, instead of one complex sentence. All in all she seems reasonably able to construct a simple declarative sentence, although sometimes reluctant to produce the verb as shown by the frequent repetitions of the subject.

A sentence anagram test was conducted in order to force HW to produce other sentence constructions than the simple SVO.¹² This task poses little problem to her. In two sentences (*hij/moet/naar/de/dokter*: he/has to go/to/the/doctor and *de/hond/wordt/door/de/man/geborsteld*: the/dog/is/brushed/by/the/man), she shows a tendency to put the human actor, expressed by an article plus noun, in the first position. By doing so, she ignores the personal pronoun which was meant to be in first position in the first sentence and the passive construction in the second. Both attempts are, however, corrected immediately.

Repetition of Words and Sentences

To assess HW's repetition abilities an experimental test was used (see Prins, 1980), as this was the only Dutch test for repetition available when HW was tested. She was asked to repeat seven (open- and closed-class) words and nine sentences, increasing in length (3 to 16 words). Normal controls have no problems performing this test; even the longest sentences are repeated faultless. Broca patients usually perform poorly in repetition of the closed-class words and sentences (as did HW when she was tested the first time). The two longest sentences are hardly ever

¹² A sentence anagram test is not, of course, an oral production test. It is discussed here because of its similarity to the other sentence construction test.

repeated correctly by aphasic patients. In HW, repetition of words is intact, whereas repetition of sentences is slightly disturbed. Although some sentences which mainly consist of closed-class words are repeated correctly, in longer sentences closed-class words are deleted. For example, *in de klas zaten alle kinderen hardop te praten* (*in the classroom all children were talking aloud*) is repeated as *in de klas alle kinderen praten hard* (*in the classroom all children talk loud*).

DISCUSSION

It is clear that HW's agrammatism is most manifest in spontaneous speech. The core of the problem seems to be the verb: in spontaneous speech, it is often omitted or not marked for tense and aspect (especially in the telegraphic part) or not in agreement with the subject (two times in the non-telegraphic part, both *ik zegt: I says* for *ik zeg: I say*). The results in the subtest "naming of verbs" prove, however, that retrieval of verbs is not the problem (as it is in the patient described by McCarthy & Warrington, 1985). Verbs are retrieved from the lexicon about as easily as nouns (and when they cannot be retrieved, an adequate description including a verb is given). When a verb is used in spontaneous speech, HW shows a strong tendency to use the infinitive, participle or first person singular present (See Bastiaanse, Jonkers, & Ruhland, 1991).

How can these data be explained by current theories of agrammatism? Both Miceli et al. (1983) and Saffran et al. (1989) distinguish two underlying disorders in Broca's aphasia. When the two spontaneous speech samples of HW were compared by applying the method of Saffran et al. (1989), it was concluded that the first (non-telegraphic) part is characterized by a disruption on the structural level; the (telegraphic) second part, however, seems to be characterized by a disturbance on both the morphological and the structural level.

The structural level concerns building sentences. It is assumed that Saffran et al.'s usage of the term "structural level" is the same as "syntactic level" as used by others, but as mentioned before, both Miceli et al. (1983) and Saffran et al. (1989) justify the division into morphological versus syntactic/structural only by stating that their suppositions are supported by linguistic theories.

In terms of Miceli et al. (1983) the first part of HW's spontaneous speech can be characterized by a mild morphological disorder: two verbs are conjugated incorrectly and sometimes the verb is not conjugated at all. This first part shows no signs of a syntactic disorder: the number of lexical verbs does not differ significantly from that of normal controls, nor does the frequency of verb inflection. This part cannot be characterized as a "disjoint sequence of phrases" either. Miceli et al. will probably characterize the second part as both morphologically and syntactically

disturbed since both lexical verbs and closed-class words are omitted.¹³ The strange thing, however, is that both parts are produced by the same person, at the same time and therefore suffering from the same underlying disorder.

Both the oral and the written language production of Caramazza and Hillis' (1989) patient M.L. were described as "agrammatic." This production was characterized by omissions and sometimes substitutions of free-standing and bound grammatical morphemes. Caramazza and Hillis used Garrett's model (1982) to argue that this phenomenon can be explained by assuming a deficit in processing the Positional Level information, because the grammatical morphemes are inserted at this level. The open-class words and major syntactic features (the linguistic structures) are specified on the Functional Level and are, according to Caramazza and Hillis, not affected in agrammatism. HW's second part of spontaneous speech and her test performance are very similar to that of M.L.; Caramazza and Hillis' assumed disorder at the Positional Level cannot account for HW's first part of spontaneous speech, however. According to Caramazza and Hillis, a disorder at Positional Level should result in impaired production of grammatical morphemes, which is hardly the case in the first part of HW's spontaneous speech.

Nespoulous et al. (1988) impute the deficit in their patient Clermont to a "reduced processing capacity," which may well be in line with the adaptation theory, as the authors mention. Caramazza and Hillis (1989) criticize this view, as it does not explain why reduced processing capacity should lead to telegraphic speech (*i.e.*, why it should affect grammatical morphemes and not open-class items?). Friederici and Kilborn (1989) are more explicit about the reduced processing capacity than Nespoulous et al. Their study on sentence comprehension in Broca's aphasia showed that the reduced processing capacity leads to a decay of the sentence traces. This decay may have selective effects: certain grammatical elements (the ones that do most syntactic work, such as closed-class items and grammatical morphemes) may be affected by the decay, meaning that they are no longer accessed automatically. Items which bear more semantic weight (open-class items) are subject to a more controlled, less automatic mode of processing and are thus less affected by a general loss of automaticity (see also Haarmann & Kolk, 1991).

¹³ The fact that the first part of HW's spontaneous speech is morphologically disturbed in the framework of Miceli et al. (1983) and structurally in the framework of Saffran et al. (1989) shows that the justification for assigning the labels "morphological" and "syntactic/structural" to variables on the base of linguistic theories, without specifying these theories, is insufficient. Still, it seems as though Saffran et al.'s assignments of the terms 'morphological' and 'structural' is more in line with linguistic theories than Miceli's et al.'s. The latter authors assume that omission of closed-class words reflects a morphological deficit and omission of lexical verbs a syntactic deficit, without specifying why this should be the case.

According to the adaptation theory, the disintegration of the syntactic representation in speech production can be prevented by selecting more simple sentence structures, for example by avoiding subordinate clauses. The patient can even leave the sentence structures and may produce only detached syntactic constituents, resulting in telegraphic speech. This is called *preventive adaptation* by Kolk and Heeschen (1990). Another way to deal with the delay in sentence representation processing is by *corrective adaptation*: when elements of the sentence representation fall apart, the patient can repair or correct the underlying representations by starting anew, resulting in repetitions and/or self-corrections. The patient may also try to repair the representations silently. In that case, long pauses will occur. When the patient does not adapt to the sentence processing delay, he will try to build sentences which are too complex for his restricted capacity: sentences will be more complex and instead of free-standing and bound grammatical morphemes being omitted, these morphemes will be substituted—in short the patient will speak *paragrammatically*. This paragrammatic speech can be elicited by special tests, such as a sentence elicitation test in which the subject has to describe a picture in such a way that a third person can identify this picture from a set of two very similar pictures.

How well does HW's behavior fit into Kolk's theory of adaptation. At least she has more than one register available; one telegraphic and one non-telegraphic. According to Kolk, the second part of her spontaneous speech must be considered as "preventively adaptive." The first part cannot be considered as "correctively adaptive." HW does not start anew (except for one phrase) nor does she correct herself, and although speech rate is delayed, she does not make long pauses, thus indicating that she does not reactivate the sentence representations.¹⁴ Can the first part then be considered to be paragrammatic? Kolk and Heeschen (1990) define paragrammatism as substitutions of closed-class words, a substantial amount of omissions, and constructional errors such as sentence blends. It is hard to state anything with certainty about substitutions in spontaneous speech in which incomplete sentences are produced, but a few substitutions of closed-class words seem to occur: *die* → *de* (*that* → *de*), *zeg* → *zegt* (*say* → *says*). Many sentences are incomplete, due to the omission of constituents (for example, *voor de tijd wist ik wel opschrijven: before the time I did know writing down* and *ik te vlug om te praten: I too fast to talk*). Sentence blends are not produced. This means that in the first part a number of paragrammatisms are produced, mainly in the form of constituent omissions.

The adaptation theory can thus account for HW's spontaneous speech

¹⁴ "Corrective adaptation" does occur, however, in the sentence construction test. Here HW often starts the sentences anew.

data, but what does adaptation mean in terms of language processing? In search of answers to this question, both parts of HW's spontaneous speech are discussed in relation to Levelt's (1989) theory. Levelt's speech production model is depicted again in Fig. 4.

Let us consider the non-telegraphic part first. A complete preverbal message is sent to the formulator and reaches the grammatical encoder, which starts retrieving the verb from the lexicon in order to build a syntactic frame. It is argued that HW's grammatical encoding is impaired. Not all lemma information is processed correctly, resulting in grammatically ill-formed sentences. It seems as though the information about the arguments belonging to the verb is ignored; the arguments are either not all filled in, resulting in incomplete sentences in which arguments are left

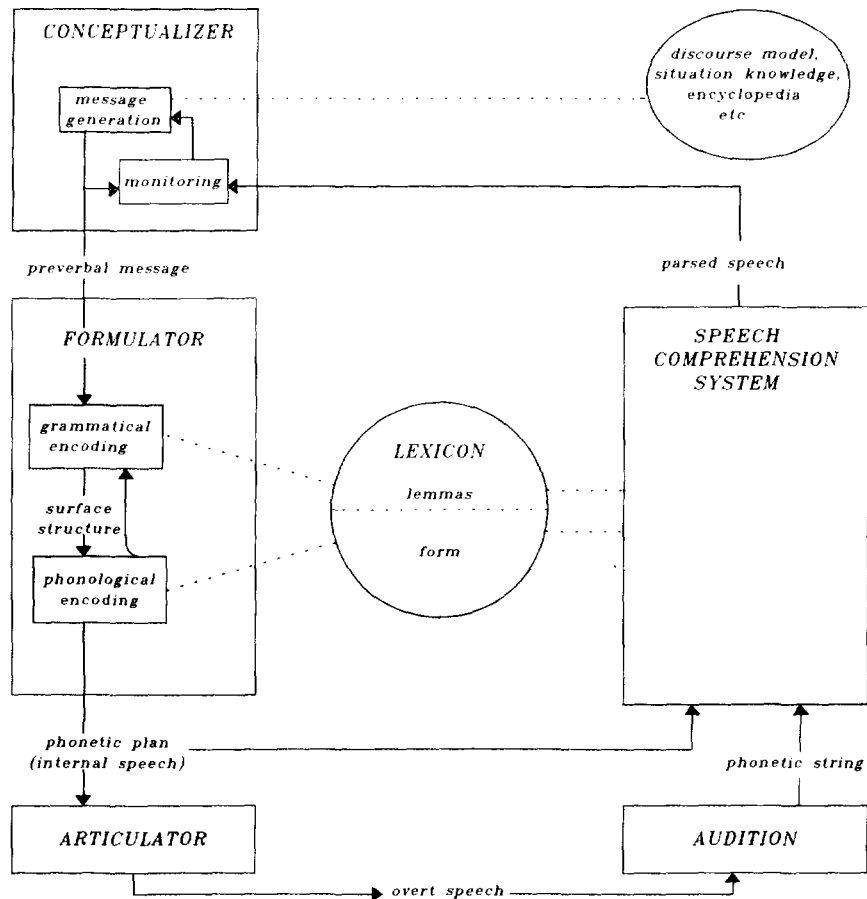


FIG. 4. Levelt's blueprint for a speaker (Levelt, 1989, p. 9).

out as in *ik schrijf op: I write down* (object deletion), or filled into the wrong slots, resulting in sentences in which the order of the arguments is incorrect, as in *niks herinnert mij: nothing remembers me*.

The results in the sentence construction test show that these errors are not caused by impaired lemma representations, in the sense of loss of part of these representations. In this test, all sentences are grammatically well formed. Apparently, when information is provided by external means (such as a picture in the sentence construction test) grammatical encoding is facilitated, but not perfect: HW is able to construct grammatically well-formed sentences now, but this is not done as fluently as in normal speakers. In the sentence construction test, the fact that she often repeats the first NP (always the actor) may mean that formulating the predicate is giving her trouble. Two explanations are possible for this phenomenon. The first is that at the beginning of the sentence, the amount of information still to be grammatically encoded is relatively large. Elements of the preverbal message decay to an activation level below the critical threshold. To retrieve the traces of the sentence representation, one can repeat the already-formed clause (*corrective adaptation*, see Kolk & Heeschen, 1990).

The other explanation is that the use of the finite verb is difficult to handle: the correct verb has to be retrieved from the lexicon and has to be brought into agreement with the subject. This is a difficult task when grammatical encoding is impaired. The results of Schlenck, Huber, and Willmes's study (1987) support this theory: numerically, prepairs (repetitions of words or phrases, as in *de jongen de jongen de jongen geeft de hond te eten: the boy the boy the boy feeds the dog*) were observed more frequently immediately before the finite verb than after.

These two explanations are not incompatible, of course. It may be the case that the traces of the preverbal message decay, *because* encoding the predicate takes so much time.

The impairment to grammatical encoding does not influence HW's performance in the sentence anagram test. All arguments are given and the verb is already in agreement with the subject. This facilitates the generation of the surface structure. Let us now consider the telegraphic part. Here the preverbal message is simplified; only the most important concepts are included and the relations between the concepts are not specified (see Kolk et al., 1985, for a specific message simplification hypothesis). Normally, verbs are used to express the relations between the concepts. When the relations are not specified, the verb can be left out and when the verb is left out, the grammatical encoder is burdened less (Kolk & Heeschen, 1992). Hence, by simplifying the preverbal messages, the conceptualizer evades HW's problems; in other words, it adapts to the impairment.

Notice that HW's grammatical encoding is not severely impaired. She

is able to build a prepositional phrase (*in de pan: in the pan; op zolder: in the attic*). Grodzinsky (1990) has already stated that in agrammatic speech governed prepositions are deleted and others retained. This is confirmed by the fact that HW does not produce a single governed preposition in the telegraphic part. Grodzinsky argues that governed prepositions are omitted, because in agrammatism the nonlexical terminals are deleted from the surface structure representations. Here it is argued that these governed prepositions were never present, since no verb phrases were built. Instead, the conceptualizer generates simplified preverbal messages. When no verb phrase is built, no governed prepositions can be expected.

Sometimes verbs are produced, but these are not used to express the relations between the arguments. They are only used to refer to actions (*na de oorlog gebouwd: after the war built; lekkers eten: eat tasty things*). Therefore they are mostly not marked for tense and aspect, but produced in a non-finite or participle form. Although HW usually does not specify the relation between the concepts by words, the relation is often specified by word order. Kerschensteiner, Poeck, Huber, Stachowiak, and Weniger (1978) have already stated that the word order in telegraphic speech is not arbitrary. All HW's telegraphic utterances are ellipses, but it is impossible to say whether she leaves out obligatory arguments, as hardly any lexical verbs are produced. No constituents are inverted, as in the non-telegraphic part, as far as the utterances can be analyzed to this respect.

In sentence repetition HW has problems in repeating long sentences. Sentences up to seven or eight words are repeated fluently. This is exactly the number of units that can be kept in working memory in normals. As the neuropsychological examination revealed, HW's verbal memory is perfect. For repeating longer sentences, one has to process the sentence first. It seems again as though in HW the impaired grammatical encoder is responsible for the ill-formed sentences: infinitive forms are used whereas finite verb forms have to be produced and other grammatical morphemes are left out (for example, *in de klas zaten alle kinderen hardop te praten: in the classroom all children were talking aloud* is repeated as *in de klas praten alle kinderen hard: in the classroom all children talk loud*). Interesting is the fact that these errors are not made at the beginning of the longer sentences. As in tests for working memory, the first units are repeated best. HW understands the sentence correctly (compare her almost perfect performance in the T.R.O.G.) and wants to express its meaning. Since during grammatical encoding the information cannot be processed, the conceptualizer has to adapt the preverbal message.

To summarize, HW's conceptualizer can use two different styles: either the normal or the telegraphic. When it uses the normal one, HW is

unable to retrieve and/or process all information about the arguments belonging to the verb, resulting in ungrammatical, non-telegraphic speech. The conceptualizer can use a telegraphic style by generating simplified preverbal messages. No verb phrases have to be built in this case. This means that the non-telegraphic speech is the consequence of the grammatical encoder trying to encode full messages. The telegraphic speech is the consequence of the fact that the conceptualizer adapts the preverbal message to the capacity of the grammatical encoder, as formulated by Kolk and Heeschen (1992).

HW's behavior is thus well in line with the adaptation theory. The question is, why should a patient produce telegraphic speech, when this is, linguistically seen, so deviant from normal speech production? The answer is that it is better from a communicative point of view: the patient in trying to generate the surface structure, does so at the cost of semantic information, since incomplete structures are produced in which much semantic information is neglected, as in the first part of HW's spontaneous speech. Analytical systems as those of Saffran et al. (1989) and Miceli et al. (1983) ignore this semantic level which is probably the most important for communication. How important such an analysis may be is shown by a post hoc analysis of HW's spontaneous speech. According to Saffran et al.'s analysis, the first part is only mildly disturbed on the structural level. The second part is severely disturbed on both the morphological and the structural level. Using this description, the second part seems linguistically worse than the first. Semantically and communicatively seen, however, the reverse is true. In the second part HW provides much more relevant information than in the first part. Many more different open-class words are produced in the second part: the type-token ratio for open-class words (nouns, lexical verbs, and adjectives) is low (.68) in the first part and normal (.75) in the second part (.74 for normal controls: Vermeulen & Bastiaanse, 1984). Hence, although HW produces the same number of nouns and verbs in the first part compared to normal controls, the semantic information she provides is less than normal. This means that HW can speak almost normally in a morphological and syntactic sense, but does so at the cost of semantic and, therefore, communicative information. When HW emphasizes the communicative content, it is at the cost of syntactic and morphological well-formedness.

The explanations of agrammatism, as mentioned by Miceli et al. (1983), Nespoulous et al. (1988) and Caramazza and Hillis (1989), can be brought into accordance with this view. Caramazza and Hillis' (1989) assumption that the Functional Level (comparable with Levelt's grammatical encoder) is intact in patients like theirs—since the open-class words and major syntactic features are already specified in telegraphic speech—can be disputed. This view cannot account for the fact that in telegraphic

speech the lexical verb (an open-class word) is often omitted (see Miceli, Silveri, Villa & Caramazza, 1984).¹⁵ The explanation given here seems to be more plausible, as it also explains the omission of the lexical verb. In terms of Garrett's model this means that the Functional Level does not work adequately. In telegraphic speech the message is simplified: no functional relations are expressed. As a consequence no verb phrases are built and hence no grammatical relations are specified. When the information reaches the Positional Level, no grammatical morphemes *can* be filled in, as no slots are available. Therefore, although in telegraphic speech the symptoms can be described at Positional Level, they are the result of a disorder earlier in processing.¹⁶

Nespoulous et al. (1988) already suggested that the disorder in their patient Clermont was due to a processing disorder. The assumption of a processing disorder in grammatical encoding can very well account for the fact that Clermont omits auxiliaries and verbs. It can also account for the fact that prepositions are omitted. Nespoulous et al. (1988) mention that especially prepositions subcategorized to verbs are left out. When no verb is retrieved to specify the relations between the concepts, no verb phrase can be built and no prepositions with a syntactic or subcategorized function can be expected.

Miceli et al.'s Case 1 (verb omissions and disjoint sequences of phrases) does not specify the relations between the concepts. Their Case 2 (omission of articles, prepositions and clitic pronouns, and infinitive substitutions) tries to express these relations, but something is going wrong: he does produce lexical verbs and subsequently makes morphological errors. In fact, the spontaneous speech of HW's first part is comparable with that of Case 2, whereas HW's second part is comparable with that of Case 1.

By assuming an impairment in grammatical encoding, to which the conceptualizer can adapt, the distinction between "morphological" and "syntactic" agrammatism can be described as a matter of strategy, instead of a matter of underlying disorder.

HW is unique, since she produces both non-telegraphic and telegraphic speech and shifts spontaneously from one to the other. Whether or not the choice between the two registers is a conscious one may be doubted. When HW is asked why she does not produce sentences although she is able to do so, she answers: 'ik te vlug om te praten, kan ik niet zoeken

¹⁵ As one of the reviewers pointed out, verb omission can also be accounted for by referring to impaired action naming, but not in Caramazza and Hillis' patient.

¹⁶ Caramazza and Miceli (1991) impute the impairment of another Broca patient (suffering from both a production and a comprehension disorder and therefore not referred to in this paper) also to a disorder on Garrett's (1982) Functional level. The spontaneous speech of this patient shows considerable resemblance to HW's first sample.

naar woorden' (I too fast to talk, I cannot search for words) and when asked why she produces short sentences, she answers: "*de, het, en laat ik weg, laat ik zomaar ...*" (*the, a, and I leave out, I just leave....*). When asked whether she does this on purpose, she answers: "Nee, o God, nee!" (No, oh God, no!).

APPENDIX 1: SPONTANEOUS SPEECH

Kun je vertellen waar je nu problemen mee hebt?
Can you tell me what are your problems?

- (1) eh praten probleem
er talking problem
- (2) ja maar moeilijke zinnestjes vormen
yes but forming difficult sentences
- (3) makkelijk als nee makkelijk als
easy when no easy when
- (4) eerst niet
first not
- (5) eh moeilijke woordjes eh te denken
er difficult words er to think
- (6) ja schiet mij niet gauw te binnen
yes doesn't soon occur to me

Je hebt moeite met het vinden van het woord
You have problems finding the words?

ja ja
yes yes

Maar je hebt ook moeite, begreep ik, met het maken van zinnestjes
But, as I understand, you also encounter problems when making a sentence?

- (7) ja het schiet mij niet
yes it doesn't come
- (8) op moment als ik schrijf eh gaat zo eh langzaam eh
at moment when I write er goes that er slow er
nee
no

Als je schrijft?
When you are writing?

- (9) ja voor de tijd wist ik wel opschrijven
yes before the time I did know writing down
- (10) eh ik schrijf op
er I write down
- (11) niks herinnert mij
nothing remembers me

Ja maar als je per se wilt kun je wel in goede zinnen spreken?
Yes, but when you really want to, can you speak in correct sentences?

ja
 yes

Waarom doe je dat dan niet?
Why don't you do that?

- (12) eh te vlug om te praten
 er too fast to talk

Hoe bedoel je, te vlug?
What do you mean, too fast?

- (13) eh ik te vlug om te praten
 er I too fast to talk

- (14) eh kan ik niet eh zoeken naar woorden
 er I cannot er search for words

Jaja, als je in zinnen praat, kun je niet zoeken naar de woorden
Yes, when you talk in sentences, you can't look for words

nee
 no

En het zoeken naar woorden is ook moeilijk?
And looking for words, is that difficult too?

ja
 yes

Daarom praat je in korte zinnetjes?
That's why you talk in short sentences?

- (15) ja de het en laat ik weg laat ik zomaar eh
 yes the a and I leave out I just leave er

Maar doe je dat expres?
Do you do that on purpose?

nee o god nee
 no oh god no

Dat gaat vanzelf?
That happens automatically?

- (16) ja ho ik hoor altijd wat ik zegt
 yes I hear always what I says

- (17) zinnetjes vlot hoor ik
 sentences quick I hear

- (18) eh en de hoor ik eh altijd eh wat ik
 er and the I hear er always er what I

verkeerd zegt
 says wrongly

Dat hoor je wel
You do hear that

ja ja
yes yes

Goed, iets anders, binnenkort is het Sinterklaas en Kerstmis
Okay, something else, it will soon be Sinterklaas and Christmas

ja ja
yes yes

heb je plannen?
do you have any plans?

(19) ja nee plannen niet niet
yes no plans not not

(20) Sinterklaas winkelsbusiness
Sinterklaas shopsbusiness

(21) mij portemonnee altijd leeg
me purse always empty

(22) toekomst nee verleden eh
future no past er

Je viert geen Sinterklaas?
Won't you celebrate Sinterklaas?

(23) nee absoluut
no absolutely

Daar doe je helemaal niets aan?
Don't you do anything?

(24) in de pan lekkers
in the pan tasty things

(25) hapjes lekker
snacks tasty

Maar geen cadeautjes?
But no presents?

nee nee
no no

En met Kerst en Oud en Nieuw, ga je dan nog wat doen?
And at Christmas and New Year's Eve, are you going to do something?

(26) eh lekkers eten
er eat tasty things

(27) cadeautjes Kerstmis
presents Christmas

(28) lootjes trekken
draw numbers

(29) allemaal eh cadeautjes halen
all er get presents

(30) tientje tientje de man
ten guilders ten guilders each

*En je gaat niet weg?
You are not going out?*

- (31) weet ik niet
I don't know

*Weet je niet
You don't know*

- (32) nee wij hebben huis verkocht ons huis
no we sold house our house

- (33) nieuwe ongeveer maart
new about March

- (34) eh eh we centen sparen
er er we saving pennies

*Ja, dat kan ik me voorstellen. Waar heb je een huis gekocht?
Yes, I can imagine. Where did you buy a house?*

- (35) in G. M-sstraat
in G. M-sstraat

- (36) centrum van G.
centre of G.

- (37) hartje in G.
the middle in G.

- (38) ah mooie plaats poeh
ah beautiful place puh

*Waar woon je nu ook weer?
Where do you live now?*

- (39) G.
G.

*Je woont al in G.?
You live in G. already?*

- (40) ja rand van G. D. op aan
yes outskirts of G. near D.

*Dat huis dat je gekocht hebt, hoe ziet dat er uit?
The house you bought, what does it look like?*

- (41) nieuwbouw premie A
new building subsidized

- (42) mooi huis oh meid
beautiful house oh dear

*Vertel eens
Tell me*

- (43) ja mooi huis
yes beautiful house

- (44) prachtig van buiten
magnificent from the outside

- (45) ramen
windows
- (46) hartstikke mooi huis
extremely beautiful house
En hoe groot is het?
And what size is it?
- (47) eh kamer eh negentig meter nee
er room er ninety meters no
Nee, dat lijkt me erg groot
No, that seems very large
- (48) nee negen meter
no nine meters
- (49) alle drempels weg oh lekker
all thresholds gone oh nice
En hoe hoog is het, hoeveel verdiepingen heeft het?
And how many floors does it have?
- (50) eh drie
er three
- (51) begane grond
ground floor
- (52) eerst slaapkamers twee douche
first bed-rooms two shower
Drie verdiepingen, boven twee slaapkamers
Three floors, upstairs two bedrooms
- (53) ja en een zolder een slaapkamer
yes and an attic a bed-room
- (54) Reinier ruzie om
Reinier row about
- (55) ik wil op zolder
I want in the attic
- (56) Renate nee ik wil op zolder
Renate no I want in the attic
En wie gaat er nou op zolder?
And who is going to the attic?
- (57) Reinier
Dat is de oudste ook hè?
That is the oldest one, isn't it?
ja ja
yes yes
En heb je zelf een slaapkamer beneden?
Do you have a bedroom downstairs yourself?

- (58) nee boven
no upstairs
- (59) ik kan wel op de trappen lopen
I can walk on the stairs
En zit er ook een tuin bij?
Is there also a garden?
- (60) ah grote
ah big one
- (61) grote achter het huis
big one behind the house
- (62) vijftien meter breedte zeventien nee zeven meter
fifteen meters width seventeen no seven meters
Dat is mooi
That's nice
- (63) ja mooi
yes nice
En is het net nieuw?
Is it brand new?
- (64) ja nou gebouwd
yes built now
Dus er staat nog helemaal niets in de tuin, begrijp ik?
So there is nothing in the garden yet?
- (65) nee nou pannen op dak
no now tiles on roof
Maar je krijgt dus een kale tuin?
So you will have a bare garden?
- (66) ja eh ach toekomst eh wel bomen
yes er ah future eh trees
- (67) appelbomen ah lekker perebomen peren
apple-trees ah delicious pear-trees pears
Ja, je wilt er wel bomen inzetten
Yes, you want to plant trees
- (68) ja bloeit mooi oh prachtig
yes blossoms beautifully oh magnificent
- (69) nou bomen kleine bomen
now trees small trees
En je gaat er in mei naar toe?
You are going to move in May?
- (70) nee eh ongeveer maart nieuwe huis opgeleverd
no er about March new house delivered
- (71) hartstikke mooi
extremely beautiful

Ben je wel blij om?

You are glad with it, aren't you?

- (72) oh mooi
oh beautiful

Je wilde graag verhuizen?

Were you eager to move?

ja
yes

Wat voor huis had je?

What kind of house did you have?

- (73) oud huis
old house

- (74) ongeveer na de nee oorlog gebouwd
about after the no war built

- (75) rijtjeshuis
block

APPENDIX 2

Raw data of part 1 (P1), part 2 (P2) and five normal controls (C) on the variables of Saffran et al. (1989). Range and standard deviation of the control subjects are given in the right most columns.

| Variable | P1 | P2 | C | Range | SD |
|------------------------|----|----|------|-------|------|
| Open-class words | 36 | 64 | 34.6 | 26-41 | 5.95 |
| Nouns | 11 | 45 | 14.2 | 11-22 | 4.66 |
| Det. required | 2 | 22 | 10.4 | 7-15 | 2.97 |
| Determiners | 1 | 8 | 10.2 | 9-14 | 2.59 |
| Pronouns | 14 | 4 | 12 | 9-14 | 2.00 |
| Verbs | 20 | 8 | 18.4 | 15-21 | 4.45 |
| Inflectable verbs | 16 | 8 | 14.8 | 13-17 | 1.48 |
| Inflected verbs | 15 | 4 | 13 | 11-16 | 2.60 |
| Matrix verbs | 15 | 7 | 13.8 | 10-16 | 2.28 |
| Aux score | 28 | 11 | 26.6 | 19-31 | 4.83 |
| No. sentences | 10 | 4 | 11 | 9-12 | 1.23 |
| Words in sentences | 56 | 14 | 80.2 | 74-88 | 5.31 |
| Words in topic-comment | 18 | 41 | 8.4 | 0-18 | 6.54 |
| Well-formed S. | 3 | 2 | 10.2 | 8-12 | 1.79 |
| SNP | 11 | 4 | 10.4 | 9-12 | 1.52 |
| Words in SNP | 11 | 4 | 10.4 | 9-12 | 1.52 |
| VP | 11 | 4 | 11 | 9-12 | 1.22 |
| Words in VP | 24 | 8 | 23.6 | 15-36 | 8.02 |
| Embedded | 3 | 0 | 1.8 | 0-6 | 2.49 |

APPENDIX 3: SENTENCE CONSTRUCTION

1. *De man bedelt*
De oude man de oude man bedelt om geld
The man is begging for money
The old man the old man is begging for money
2. *De vrouw wast de koffiepot af*
De vrouw wast de theekan af
The woman is cleaning the coffeepot
The woman is cleaning the teapot
3. *De jongen speelt met de hond*
De jongen de jongen de jongen geeft de hond eten
The boy is playing with the dog
The boy the boy the boy feeds the dog
4. *De man vist een laars op*
De man vist in de waat nee de man heeft een laars aan de haak
The man fishes a boot out of the water
The man fishes in the wat no the man has a boot on the hook
5. *De jongen breekt een glas*
De jongen de jongen laat een vaas vallen huilt
The boy breaks a glass
The boy the boy drops a vase cries
6. *Vader en zoon spelen indiaantje*
De indiaan de indiaan knoopt de indiaan maakt de man vast aan de boom
Father and son are playing indians
The indian the indian buttons up the indian fastens the man on the tree
7. *De politieagent arresteert de dief*
Politieagent de politieagent maakt handboeien vast
The policeman arrests the thief
Policeman the policeman fastens handcuffs
8. *Twee mannen maken ruzie*
Twee mensen praten met mekaar
Two men are having an argument
Two people are talking to each other
9. *De juffrouw schrijft iets op voor het meisje*
De juffrouw schrijft woord op het bord
The teacher writes something on the blackboard for the girl
The teacher writes word on the blackboard
10. *De man ligt op de bank, rookt een pijp en leest de krant*
De man ligt op de bank te hij rookt een pijp hij leest de krant
The man is lying on the couch, smoking a pipe and reading the newspaper
The man is lying on the couch to he is smoking a pipe he is reading the newspaper

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