1. Introduction

Studies on the retrieval of lexical verbs in Broca's aphasics are often restricted to the comparison of the scores on action and object naming in these patients. It has been reported that, for Broca's aphasics, verbs were more problematic than nouns, whereas, for anomics, nouns were more problematic than verbs (e.g. Miceli, Silveri, Villa, and Caramazza, 1984). Basso, Razzano, Faglioni, and Zanobio (1990), however, found no differences between action naming and object naming for the Broca's and anomic aphasics they tested. Finally, Williams and Canter (1987) and Kohn, Lorch, and Pearson (1989) found a specific deficit for verbs as compared to nouns in all aphasics, who participated in their studies, among which there were Broca's aphasics and anomics.

Bastiaanse (1991) showed, in an experimental study, that the performance of aphasics in action naming may depend on the type of the elicited verb. The results of her study showed that name-relation of a verb with a noun influenced the scores of Dutch Broca's and anomic aphasics on an action naming task.

It has been suggested that several factors might influence noun retrieval (e.g. word frequency, imageability, familiarity), but it is unclear which factors influence the retrieval of verbs. From the study of Bastiaanse it can be concluded that name-relation with a noun is one of these factors. As Broca's aphasics suffer from a syntactic deficit, it might be assumed that a syntactic factor plays a role in verb retrieval in these patients. Therefore, in the present study, the effect of a such a factor on verb retrieval, i.e. transitivity, will be evaluated.
2 Transitivity and verb retrieval

Lexical entries of a verb contain, next to its meaning and its phonological form, several kinds of syntactic and semantic information. The different syntactic and semantic elements of the lexical entry will be outlined below, following Chomsky's Government and Binding (Chomsky, 1981) and Principles and Parameters (1986) framework. The lexical entry of *to give*, for example, consists of the following information:

[EXAMPLE 1]

The lexical entry contains word-class information. In this case, the syntactic category V (verb) is indicated. The syntactic complements represent the subcategorization frame of the verb. The subcategorization frame specifies the syntactic environment into which a verb can be placed. The verb *to give* has two possible complement structures. One \[_{NP} NP\] is necessary in order to produce sentences like (2).

[EXAMPLE 2]

In this case, apart from the subject, an indirect object and a direct object are produced. Instead of the production of an indirect object, an oblique complement may be produced by using a prepositional phrase (PP). This accounts for sentences like (3).

[EXAMPLE 3]

Subcategorization is used as well-formedness information. Sentences must satisfy the *Projection Principle* (Chomsky, 1981):

[EXAMPLE 4]

This means that sentences must satisfy the complement structure of a verb. Therefore, a sentence like (5) is ungrammatical because one complement is missing.

[EXAMPLE 5]
The argument structure representation is also used as syntactic well-formedness information. The verb to give has three arguments which are represented as variables (x, y, z). Argument structure is concerned with the number of participants expressed by the conceptual representation. The verb to give requires three participants, a giver, a receiver and a given object, as is represented in (6).

[EXAMPLE 6]

The arguments that fall within the domain of the verb (y,z) are internal arguments, whereas (x), falling outside this domain, is an external argument.

Verbs requiring three arguments are called three-place verbs. Apart from these, one-place (e.g. to skate), two-place (e.g. to grind), and four-place verbs (e.g. to exchange) exist. All arguments must be specified in a sentence in order to make it well-formed, following the Projection Principle. The example in (5) is not well-formed because one complement/argument position is unspecified.

The argument structure of a verb interacts with the specification of its semantic or thematic roles, the thematic structure. The verb to give has three thematic roles, the agent (the one who performs the action of giving), the theme (the thing that is given), and the recipient (the one who gets the thing that has been given). During sentence construction, thematic roles are assigned to the arguments of the verb. Within the Government and Binding framework, this assignment is based on the Theta Theory. This theory states that theta-roles are assigned to arguments by a theta-assigner (i.e. lexical categories like verbs, prepositions, nouns and adjectives). This assignment is constrained by the Projection Principle (see (4)) and the Theta Criterion (Chomsky 1981):

[EXAMPLE 7]

This means that the thematic roles, specified by the lemma, will be assigned to the arguments in a one-to-one fashion. The verb give will assign the role of agent to the boy, the one who performs the action, the role of theme to the book, the object that is
4 Transitivity and verb retrieval

given and the role of recipient to the girl, the person who is receiving the theme, as is shown in (8).

[EXAMPLE 8]

In order to create the syntactic structure, the complements have to be mapped onto the structure in (8). The NP boy will be subject, the NP book will be the direct object, and the NP girl will be the indirect object.¹

Thompson, Lange, Schneider and Shapiro (1997) showed that the verb argument structure influenced verb retrieval of Broca's aphasics in test conditions. No effect of argument structure was found in a confrontation verb naming task, but sentence production was influenced by the number of arguments a verb requires: Broca's aphasics preferred the least complex verbs, namely verbs requiring one argument, like to ski. Comparable scores were found by Kiss (this book) in a sentence construction task in two Hungarian Broca's aphasics. Thompson et al. (1997) also reported that the number of possible argument structure arrangements played a role. Two-place verbs, in which both arguments are obligatory, have only one argument structure. This is the case for to kiss, as is clear from the examples (9) and (10).

[EXAMPLE 9]

[EXAMPLE 10]

These verbs are called obligatory two-place verbs. There are, however, also verbs in which one of the arguments is not obligatorily realized, the so-called optional two-place verbs. For these verbs the absence of the internal argument does not make the sentence ungrammatical as is shown in the examples (11) and (12).

[EXAMPLE 11]

[EXAMPLE 12]

¹ See Shapiro (1997) for a comprehensive introduction to the notions subcategorization, argument structure and thematic roles
These *optional two-place verbs* are supposed to have two argument structure arrangements, one with and one without the internal argument realized in the syntax. Thompson et al. found that sentences with verbs with only one argument structure were more often correctly produced than sentences with verbs with more possible argument structures.

Thompson et al. (1997) also showed that the *thematic structure* of the verb plays a role in sentence construction. They found the following order of difficulty: sentences with only an Agent or an Experiencer role were significantly more often correct than sentences with a Theme/Patient role, which in turn were better preserved than sentences with a Goal/Location role.

The studies of Thompson et al. and Kiss (this book) focused on the *argument structure* and the *thematic structure* of the verb. The present study concentrates on the *subcategory frame* of the verb by considering the effect of the syntactic factor *transitivity*.

As far as is known, the effect of transitivity on verb retrieval has never been studied in aphasia research. The influence of this factor on verb retrieval in children has been investigated by Davidoff and Masterson (1996). They showed that children have more problems in naming pictures of intransitive than of transitive verbs, suggesting that intransitive verbs are more difficult to retrieve than transitive verbs.

In the present study, verb retrieval, in isolation and in sentence context, by Broca's aphasics will be investigated, focusing on the effect of *transitivity*.

2. Methods and Materials

*Subjects*
The study included 15 Broca's aphasics, all native speakers of Dutch. The diagnosis of Broca's aphasia was based on the classification of the Dutch version of the Aachen Aphasia test (Graetz, De Bleser and Willmes, 1992) and was confirmed by clinical judgement of a person who did not know the patients. Patient data are presented in table 1.
6 Transitivity and verb retrieval

[Table 1]

All Broca's aphasics suffered from a single stroke. The patients did not have major auditory or visual problems. For comparison the scores of a group of 15 healthy subjects were used who matched the aphasic group in age, sex and social background.

Materials
A confrontation naming (action naming) and sentence production (sentence construction) task were administered. Since naming-to-picture tests were used, all items were highly imageable. Both tests consisted of 60 items. The verbs in the action naming and in the sentence construction task were different, but the items in action naming matched fully with the items of the sentence construction test. The verbs were controlled for transitivity (see below) and two other linguistic factors: instrumentality of the verb and name relation to nouns (cf. Bastiaanse, 1991).

Frequency
The items in the tests were matched for word-frequency using the CELEX frequency lists for Dutch (Burnage, 1990).

Transitivity
To evaluate the effect of transitivity, the 60 verbs were divided into two subgroups: 30 intransitive verbs and 30 transitive verbs. Transitive verbs were those verbs that required a direct object, like to grind and to scratch, whereas intransitive verbs were verbs that could not have a direct object, like to fence and to swim. The transitive verbs were matched for frequency with the intransitive verbs. Within the class of transitive verbs, some grammarians make the distinction between pure transitives and so-called pseudo-transitives. Pseudo-transitives are, in principle, transitive but these verbs may also occur without a direct object, like to milk or to saw. Nevertheless, these verbs are considered to be transitive. Thompson, Shapiro, Tait, Jacobs and Schneider (1996) indicate that with these verbs one always assumes an
object, although it is not always lexicalized (e.g. in order to milk there always has to be some animal that is milked, like a cow).

The verbs that were used in the subtests were not specifically controlled for the thematic structure of the verb. All items, however, concerned action verbs, which means that the thematic structure was either Verb + agent, theme/patient (transitive verbs), or Verb + agent (intransitive verbs).

An example of each type of verb with respect to transitivity, taken from the verb tests, is presented in figure 1.

[FIGURE 1]

Reliability

Reliability of the tests was calculated using the odd-even coefficients. Correlation between the two parallel halves was corrected for length using the Spearman-Brown formula. The odd-even reliability for action naming was $r=0.96$ (p<0.001) and for sentence construction was $r=0.90$ (p<0.001).

Procedure

All aphasics were tested using the same procedure. A picture was shown to the patients and they were asked to tell either in one word (action naming) or in a sentence (sentence construction) what the person on the picture was doing. Both tests started with two examples. Patients who gave an inadequate response to one of these were corrected. If a patient produced (part of) a sentence for the examples of action naming he was asked to react in one word. In cases where the patient produced an incomplete sentence in sentence construction he was requested to produce a complete sentence. After the examples no more feedback was given. There was no time limit; self corrections were allowed and scoring was based on the final answer.

The tests were administered in two sessions. Action naming was carried out in one session and sentence construction in another. The order of the two sessions was assigned randomly to the patients such that some of the patients were tested first with the sentence construction test and others with the action naming test. There was at least a fourday interval between the sessions.
8 Transitivity and verb retrieval

Scoring
The test sessions were tape-recorded. In scoring action naming, a count was given if the correct verb was retrieved. It was not considered whether it was produced as a single word. This means that if a patient produced the correct verb within a (part of a) sentence, then the reaction was counted as correct. In sentence construction, a count was first given in terms of whether the intended verb was retrieved. Next, the production of subjects and objects in sentence construction was examined. This was done in order to account for a possible relation between an effect of transitivity and the realization of the syntactic complements that belong to the verb.

3. Overall results on verb retrieval

Overall results for action naming and sentence construction by both groups are presented in table 2.

|TABLE 2|

The controls performed significantly better than the Broca's aphasics in verb retrieval in isolation (t(28)=11.1, p<0.001) and in sentence context (t(28)=11.2, p<0.001). Verb retrieval in isolation did not differ from verb retrieval in sentence context within both subject groups (Broca's aphasics: t(14)=0.80, p>0.05; controls: t(14)=1.19, p>0.05).

4. The effect of transitivity on verb retrieval

Table 3 shows the results for the action naming and sentence construction tasks of the Broca's aphasics and the controls with respect to effect of transitivity on verb retrieval.

|TABLE 3|

Transitive verbs received higher scores than intransitive verbs by the Broca's aphasics at the word level (t(14)=4.70, p<0.001). At the sentence level, this difference disappeared (t(14)=0.09, p>0.05). No effect of transitivity was found in the controls (action naming: t(14)=0.69, p>0.05; sentence construction t(14)=2.09, p>0.05).
In conclusion, transitivity was shown to have an effect on verb retrieval in isolation, but not in sentence context, by the Broca's aphasics. It was decided that a closer look at the data of the Broca's aphasics was needed in order to find out why an effect of transitivity was found only at the word level and not at the sentence level.

5. A closer look at the data

The individual scores on action naming and sentence construction showed that within the group of Broca's aphasics, different performance patterns could be distinguished. Half of the patients performed better in action naming than in sentence construction, whereas the other half showed the opposite pattern. The patients were divided into two subgroups on the basis of this distinction in their scores on the two tests. The patients in subgroup 1 (7 subjects) performed better in action naming than in sentence construction, whereas those in subgroup 2 (8 subjects) had a better performance in sentence construction than in action naming. In table 4, the mean group scores are presented.

<table>
<thead>
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<th>TABLE 4</th>
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<tr>
<td>The scores in table 4 reveal that, although the group of Broca's aphasics as a whole had comparable scores for action naming and sentence construction, subgroup 1 was significantly better in verb retrieval at the word level than at the sentence level (t(6)=3.62, p&lt;0.02), whereas for subgroup 2 the opposite was true (t(7)=6.00, p&lt;0.002).</td>
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</table>

Transitivity had an effect on action naming but not on sentence construction when the scores of all Broca's aphasics were looked at. Below, it will be considered whether the same holds for the subgroups. First, a descriptive analysis will be presented. In figure 2, the individual scores on verb retrieval in isolation and in sentence context by the Broca's aphasics are depicted in two scatterplots. In these scatterplots a division into subgroups is projected in relation to transitivity.

| FIGURE 2 |
The sloping line in the scatterplots in figure 2 divides the group into those patients who were better in retrieving transitive verbs than intransitive verbs (depicted under the line) and those who showed the opposite pattern (depicted above the line). Twelve of the fifteen patients had higher scores for transitive than for intransitive verbs in action naming. This shows that the effect of transitivity, found at the word level, is present in most of the individual patients. This contrasts to the pattern found for verb retrieval in sentence context. The scores of all except two patients in subgroup 1 are plotted below the sloping line, meaning that they performed better on transitive verbs than intransitive verbs. All patients in subgroup 2 showed the opposite pattern: a better performance on intransitive than transitive verbs.

The effect of transitivity will be discussed further in the following section.

6. The effect of transitivity on the scores of the subgroups

Table 5 gives the scores of both subgroups on action naming and sentence construction with respect to transitivity. In figure 3, these scores are depicted graphically.

Subgroup 1 (action naming > sentence construction) was significantly better in naming transitive than intransitive verbs in isolation (t(6)=3.58, p<0.02) and in sentence context (t(6)=2.49, p<0.05). Subgroup 2 (sentence construction > action naming) also produced significantly more transitive verbs than intransitive verbs in isolation (t(7)=3.00, p<0.05), but, at the sentence level, this group was significantly better in retrieving intransitive than transitive verbs (t(7)=3.91, p<0.01).

From these results it can be concluded that, although the Broca's aphasics behave like a homogeneous group at the word level, they split into two subgroups at the sentence level, behaving differently with respect to the effect of transitivity.
7. The production of subjects and objects

The production of subjects and objects was evaluated in order to find out whether *transitivity* played a role in the production of these verb complements. Subject and object complements were only counted in sentences containing the target verb. Table 6 gives an overview of the results of the subgroups with respect to the subject and object production and the effect of *transitivity*.

**[TABLE 6]**

Subject complements were produced significantly more often with a transitive than with an intransitive verb in subgroup 1 (t(6)=2.55, p<0.05). No difference was found between intransitive and transitive verbs as far as the number of subject complements is concerned in subgroup 2 (t(7)=0.73, p>0.05).

An object was produced with 64% of the transitive verbs in subgroup 1, whereas subgroup 2 only produced an object with 28% of the transitive verbs. It was, however, not always necessary to produce an object. If only obligatory contexts for objects were taken into account, the number of objects reached 80% for subgroup 1 and 38% for subgroup 2. Subgroup 1 produced both the subject and the object with 55% and subgroup 2 with 16% of the transitive verbs.

It is clear that at the sentence level the two groups of Broca's aphasics not only differed with regard to the effect of *transitivity* on verb retrieval, but also in the production of subjects and objects.

8. Summary

Verb retrieval in Broca's aphasics and the effect of the syntactic factor *transitivity* on retrieval was analyzed. No differences were found between the scores for action naming and sentence construction. *Transitivity* was shown to affect verb retrieval. When simple actions had to be named, transitive verbs were better preserved than intransitive verbs. The test for sentence construction revealed that two groups could be distinguished. The first group was better in action naming than in sentence
Transitivity and verb retrieval

construction, but the effect of *transitivity* was the same in verb retrieval in isolation and sentence context: transitive verbs were better preserved than intransitive verbs. Subject complements were more frequently produced with transitive than with intransitive verbs. The number of object complements realized with the transitive verbs was relatively high.

The second group demonstrated an opposite effect of *transitivity* at the word and sentence levels. Contrary to verb retrieval in isolation, this group retrieved more intransitive than transitive verbs in sentence context. The number of subjects and objects obtained with the correctly retrieved verbs was relatively low.

9. Discussion

The present study showed that verb retrieval in Broca's aphasics may be influenced by the type of verb. A syntactic factor, *transitivity*, played a role in verb retrieval in these aphasics. Transitive verbs were easier to retrieve than intransitive verbs in action naming. In this final section, why transitive verbs were easier to retrieve for all Broca's aphasics at the word level and only for some of them at the sentence level will be discussed.

The effect of *transitivity* is explained by focusing on the syntactic information that is stored with the verb. First, however, whether the effect that was found could be due to the fact that the present study only used tests containing pictorial materials will be discussed. With respect to *transitivity*, Canseco-Gonzalez, Shapiro, Zurif and Baker (1990) have pointed out the possible influence of visual artifacts. According to these authors, there is a relationship between argument structures and visual information: 'argument structures are shaped by the form in which visual information is parsed' (p. 402). In a therapy study concerning comprehension in a Broca's aphasic, they found that an extra element depicted in the picture facilitated performance only when this element was an argument. When this element was an adjunct, it disrupted learning. It may thus be argued that transitive verbs in the present study were easier to name because all arguments were depicted and that the intransitive verbs were more difficult, despite the fact that often an element that was not an argument was in the picture. The picture for
the verb *to climb*, for example, showed a mountain. For verbs like *to kneel*, however, nothing but the agent was depicted.

This is a serious point to consider but there is reason to assume that the relation between the number of elements in the picture and the number of arguments was not the critical factor in the present study: the transitivity effect in half of the aphasics was different at the word and the sentence level. For these aphasics, in sentence context, intransitive verbs were easier to retrieve than transitive verbs, whereas facilitation of an argument arose at this level in the Canseco-Gonzalez et al. study.

Davidoff and Masterson (1996) considered that the children's problems with intransitive verbs may have been due to difficulties in picture interpretation. Therefore, they performed a second study using video clips. Comparable results were found, showing that the transitivity effect did not seem to be due to the interpretation of pictures.

As already stated, the performance of the Broca's aphasics will be explained by concentrating on the syntactic information that a verb carries. According to Thompson et al. (1997), all syntactic information is activated when the verb is retrieved, not only in sentence construction, but also in action naming. They argue that if the number of arguments and subsequently the amount of syntactic information increases, the verb becomes more difficult to activate. This implies that transitive verbs, bearing more syntactic information than intransitive verbs, would be more difficult to retrieve than intransitive verbs, both in isolation and in sentence context. However, this was not found in the present study: A larger amount of syntactic information does not make verbs more difficult to retrieve. On the contrary, transitive verbs were easier than intransitive verbs.

The amount of syntactic information stored with the verb was demonstrated to affect sentence construction. It will, however, be argued that the more syntactic information a verb contains, the more difficult sentence construction becomes, but not that the verb becomes more difficult to retrieve.

In the next subsection, the fact that transitive constructions are more frequent in language and thus they are easier to retrieve than intransitive verbs for patients with a syntactic deficit will be discussed.
The transitivity effect in action naming

The lexical entry of a transitive verb differs from the one of an intransitive verb, as is shown in figure 4.

[FIGURE 4]

The verb phrases that belong to these verbs also differ. For an intransitive verb only a V is specified, for a transitive verb both a V and an NP-object is specified.

In the spontaneous speech of normal subjects, transitive verbs with one internal argument occur three times more often than intransitive verbs. This is true not only for Dutch but also for English and Hungarian (Bastiaanse, Edwards and Kiss, 1996; Edwards and Bastiaanse, 1997). A related study showed that in spontaneous speech, Broca's aphasics also used more transitive than intransitive verbs, just like normal subjects (Bastiaanse and Jonkers, 1998). The relative high frequency of transitive verbs is also demonstrated by the CELEX frequency list of Dutch (Burnage, 1990): from the 150 most frequent main verbs, 100 are transitive while 50 are intransitive.

Arguing along the lines that there is a direct relationship between activation threshold and frequency of use, transitive verbs in general are more often retrieved and as a consequence the corresponding verb phrases are more readily available. Broca's aphasics suffer from a syntactic impairment, making it difficult to process all the syntactic information that is stored with a verb. This also holds for verb retrieval in isolation, meaning that even for verb retrieval in isolation the verb phrases are retrieved. As the verb phrase for transitive verbs is more readily available, these verbs are easier to produce than intransitive verbs.

The ability of the Broca's aphasics to retrieve verbs is then assumed to be influenced by a syntactic factor: the frequency of a grammatical construction. Note that this has nothing to do with word frequency. The intransitive and transitive verbs were matched for word frequency.
The transitivity effect in sentence construction

The transitivity effect that was found at the word level for all Broca's aphasics was found at the sentence level in only those patients who scored higher in action naming than in sentence construction (subgroup 1). The patients who were better in verb retrieval at the sentence level (subgroup 2), produced more intransitive verbs than transitive verbs in sentence construction.

It is tempting to claim that those Broca's aphasics who were better in verb retrieval at the sentence level were less severely aphasic. If, however, the production of subject and object complements was taken into account, it was seen that subgroup 1 produced subjects relatively often, particularly when a transitive verb was activated. Also, in transitive sentences, the object was usually produced. This means that when these patients retrieved the verb, they tried to make complete sentences. Subgroup 2 produced fewer subject complements with both intransitive and transitive verbs and the patients in this group regularly omitted object complements, showing that they made 'incomplete sentences'.

Problems in sentence production are the core features of Broca's aphasia and therefore it is not surprising that both subgroups have problems in sentence production. The way these problems appear, however, differs.

Two patterns of sentence production problems

The fact that transitive verbs were easier to retrieve than intransitive verbs for subgroup 1 has already been explained with respect to action naming. In sentence construction, the patients in subgroup 1 tried to process all the syntactic information that is stored with a verb, in order to make a complete sentence. They often produced both the subject and an object complement. How does this explain the fact that they produced fewer verbs in sentence context than in isolation?

These patients wanted to process the complete amount of syntactic information that is stored with a verb in the lexicon, as is clear from the relatively preserved production of subjects and objects in those cases that the correct verb was retrieved. They were, however, often unable to process all the syntactic information, due to their syntactic problems. This lead to problems in verb retrieval as such. In isolation, verbs were easier
Transitivity and verb retrieval

to retrieve, because at the word level, the syntactic information of a verb did not have to be processed in order to make a sentence.

The patients in subgroup 2 were better in verb retrieval in sentence context than in isolation. This suggests that they profited from a sentence frame in verb retrieval: a sentence frame fits with the syntactic information that is activated with the verb. Nevertheless, these patients did, of course, also have problems in sentence processing. They were unable to process the complete amount of syntactic information that was necessary for sentence construction, leading to, for example, the regular omission of object complements.

The preference for intransitive over transitive verbs in sentence context can be retraced to the fact that intransitive verbs contain less syntactic information than transitive verbs. Hence, the patients in subgroup 2 were able to construct a sentence frame, but they were unable to process a large amount of syntactic information in order to fill this sentence frame.

In sum, there are two ways in which the sentence production problems show up in the aphasics in the present study. Some patients tried to process all syntactic information in order to make complete sentences (i.e. with the subject and object complements), leading to verb production problems in sentence context. Other patients tried to produce simple sentences (i.e. without object complements), not using the complete amount of syntactic information, reducing the verb production problems in sentence context as compared to retrieval in isolation.

How do the results in this chapter relate to studies that considered the effect of verb argument and thematic structure on verb retrieval in Broca's aphasics?

Thompson et al. (1977) and Kiss (this book) found that Broca's aphasics preferred verbs with one argument in sentence production. This pattern fits with the pattern found for the subgroup in the present study that produced more intransitive than transitive verbs correctly. These patients also had a preference for simple sentences with only a subject and a verb.

The other subgroup produced more complex sentences. This differs from the outcomes of Thompson et al. and Kiss. The patients in this subgroup have, however, more
problems with verb retrieval, as such, in sentence context than in isolation. Although Thompson et al. did not find such patients in their study, they concluded that it may be both the verb and its grammatical information that could lead to sentence production problems. According to them it is a ‘complex mixture of verb and syntactic variables that influence sentence complexity and production.’ (Thompson et al. 1997: 487).

Conclusion

From the results presented in this study, it may be concluded that the syntactic information stored with the verb plays an important role in verb retrieval for patients with a syntactic deficit. It was shown that more syntactic information does not make a verb more difficult to retrieve, but it does make sentence processing more difficult. In this respect, the results are in line with those of Thompson et al (1997) and Kiss (this book), who found that in sentence construction Broca's aphasics preferred simple sentences with only one argument.

In the present study, patients reacted differently to the large amount of syntactic information that has to be processed in sentence construction. One group of patients tried to produce complete sentences using the entire amount of syntactic information, which distorted verb production. The other group attempted to make simple constructions. This made verbs easier to retrieve but led to sentences that were incomplete and objectless.

Acknowledgements

I thank the patients for their co-operation. Roelien Bastiaanse, Yosef Grodzinsky, Dirk Den Ouden and Laura Sabourin are acknowledged for their helpful comments on an earlier draft of this article. The research of the author was supported by the Foundation for Language, Speech and Logic, which is funded by the Netherlands Organization for Scientific Research (NWO).
References


Examples

(1)  * syntactic category: V
     * syntactic complements (subcategorization): [ _NP NP] or [ _NP PP]
     * argument structure: (x,y,z)
     * thematic structure: (agent, theme, recipient)

(2)  The boy gives the girl (NP) the book (NP)

(3)  The boy gives the book (NP) to the girl (PP)

(4)  Projection Principle: Representations at each syntactic level are projected from the lexicon, in that they observe the subcategorization properties of lexical items

(5)  *The boy gives the girl

(6)  [The boy x] [gives [the girl y] [the book z]]

(7)  Theta Criterion: each argument bears one and only one theta-role, and each theta-role is assigned to one and only one argument

(8)  GIVE (boyagent, booktheme, girlrecipient)
(9) The man kisses the woman
(10) "The man kisses

(11) The man drinks a beer
(12) The man drinks
TABLES

Table 1: Patient data of the Broca's aphasics (CVA: cerebro vascular accident; L: left hemisphere; R: right hemisphere; CT: CT-scan; EEG: Electro Encephalography; MPO: months post onset; m: male; f: female; rec.: recovered; *: congenital missing of the right arm)

Table 2: Mean and standard deviation (sd) of action naming and sentence construction scores

Table 3: Mean and standard deviation (sd) of the action naming and sentence construction scores with respect to the factor transitivity

Table 4: Mean and standard deviation (sd) of the action naming and sentence construction scores in the subgroups

Table 5: Mean and standard deviation (sd) of the action naming and sentence construction scores in the subgroups with respect to transitivity (subgroup 1: action naming > sentence construction; subgroup 2: sentence construction > action naming)

Table 6: Mean and standard deviation (sd) of the proportional scores for the production of subjects and objects in the subgroups (subgroup 1: action naming > sentence construction; subgroup 2: sentence construction > action naming)
<table>
<thead>
<tr>
<th></th>
<th>age</th>
<th>etiology</th>
<th>localisation</th>
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<th>paresis</th>
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<td>45</td>
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<td>+</td>
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<tr>
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<td>61</td>
<td>CVA-L</td>
<td>area middle cerebral artery</td>
<td>11</td>
<td>m</td>
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<tr>
<td>B6</td>
<td>72</td>
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<td>89</td>
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<tr>
<td>B7</td>
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<td>parietal (CT)</td>
<td>5</td>
<td>m</td>
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</tr>
<tr>
<td>B8</td>
<td>53</td>
<td>CVA-L</td>
<td>occipito-parietal (CT; slight signs)</td>
<td>12</td>
<td>m</td>
<td>rec.</td>
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<td>B9</td>
<td>66</td>
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<td>area middle cerebral artery (CT; large area)</td>
<td>37</td>
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<td>+</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(EEG: fronto-temporal)</td>
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<td>B10</td>
<td>51</td>
<td>CVA-L</td>
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<td>10</td>
<td>f</td>
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<tr>
<td>B11</td>
<td>63</td>
<td>CVA-L</td>
<td>fronto-temporal (CT)</td>
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<td>f</td>
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<td>B12</td>
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<td>temporo-parietal (CT)</td>
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<tr>
<td>B13</td>
<td>48</td>
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<td>area middle cerebral artery (CT; large area)</td>
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<td>B14</td>
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<td>B15</td>
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Mean: 58.3 46.7
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<tr>
<th></th>
<th>action naming</th>
<th>sentence construction</th>
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<tbody>
<tr>
<td><strong>BROCA'S APHASICS (N=15)</strong></td>
<td>22.6 (10.8)</td>
<td>24.1 (9.6)</td>
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<tr>
<td>mean (sd)</td>
<td>54.6 (2.9)</td>
<td>53.4 (3.3)</td>
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<tr>
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<tr>
<td>mean (sd)</td>
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<td>action naming</td>
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<tr>
<td>mean (sd)</td>
<td>12.7 (6.0)</td>
<td>9.9 (5.0)</td>
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<tr>
<td><strong>CONTROLS</strong></td>
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<td></td>
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<tr>
<td>mean (sd)</td>
<td>27.5 (1.6)</td>
<td>27.1 (1.8)</td>
</tr>
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<td>action naming</td>
<td>sentence construction</td>
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<td><strong>SUBGROUP 1 (N=7)</strong></td>
<td>25.6 (11.7)</td>
<td>20.6 (10.9)</td>
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<td>mean (sd)</td>
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<td></td>
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<tr>
<td><strong>SUBGROUP 2 (N=8)</strong></td>
<td>20.0 (10.0)</td>
<td>27.1 (7.6)</td>
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<tr>
<td>mean (sd)</td>
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<td></td>
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<tr>
<td><strong>ALL BROCA'S APHASICS</strong></td>
<td>22.6 (10.8)</td>
<td>24.1 (9.6)</td>
</tr>
<tr>
<td>mean (sd)</td>
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### Verb retrieval in isolation

<table>
<thead>
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<th>Subgroup</th>
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<th>intransitive mean (sd)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroup 1 (N=7)</td>
<td>14.4 (6.8)</td>
<td>11.1 (5.0)</td>
<td>p&lt;0.02</td>
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<tr>
<td>Subgroup 2 (N=8)</td>
<td>11.1 (5.1)</td>
<td>8.9 (5.1)</td>
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### Verb retrieval in sentence context

<table>
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<th>intransitive mean (sd)</th>
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</thead>
<tbody>
<tr>
<td>Subgroup 1 (N=7)</td>
<td>11.4 (5.6)</td>
<td>9.1 (5.6)</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>Subgroup 2 (N=8)</td>
<td>12.6 (3.8)</td>
<td>14.5 (3.9)</td>
<td>p&lt;0.01</td>
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### Production of subjects

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Transitive (Mean ± SD)</th>
<th>Intransitive (Mean ± SD)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (N=7)</td>
<td>80.6 (17.6)</td>
<td>57.9 (36.4)</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>2 (N=8)</td>
<td>61.7 (33.4)</td>
<td>55.2 (29.3)</td>
<td>p&gt;0.05</td>
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</table>

### Production of objects

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Object (Mean ± SD)</th>
<th>Subject + Object (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (N=7)</td>
<td>63.9 (22.2)</td>
<td>55.4 (22.1)</td>
</tr>
<tr>
<td>2 (N=8)</td>
<td>27.8 (17.3)</td>
<td>15.7 (15.6)</td>
</tr>
</tbody>
</table>
FIGURES

Figure 1: examples of an intransitive verb (*fencing*; Dutch: *schermen*), a pseudo-transitive verb (*milking*; Dutch *melken*), and a transitive verb (*grinding*; Dutch: *malen*).

Figure 2: Scatterplots of the individual action naming and sentence construction data with respect to the factor *transitivity*. Subjects with higher scores in verb retrieval in isolation are represented by a diamond, subjects with higher scores in verb retrieval in sentence context are represented by a circle.

Figure 3: The subgroups’ performance on the factor *transitivity* at the word and the sentence level (subgroup 1: action naming > sentence construction; subgroup 2: sentence construction > action naming).

Figure 4: The lexical entry of an intransitive and a transitive verb.