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Verb and sentence processing in Norwegian aphasic speakers compared to Dutch and English aphasic speakers: experimental evidence

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Abstract

The article reports on a comparative study of the abilities of aphasic speakers and normal control subjects to comprehend and produce verbs and sentences. The analysis is based on test results obtained as part of the standardization procedure for a test battery originally developed for Dutch and since translated and adapted for English and Norwegian. With a few exceptions, there is extensive similarity in the test results between the different languages. The exceptions can be accounted for with reference both to structural differences between the languages and to coincidental aspects of informant selection and scoring procedures. The Norwegian version contains an additional subtest on past tense inflection, which correlates significantly with at least two other subtests in the test battery.

Key words: aphasia, verb and sentence processing, Norwegian, cross-linguistic, assessment

Introduction

Verbs are dynamic and relational concepts that are cognitively complex and communicatively important. In aphasia, verbs seem to be particularly vulnerable, and although the picture is far from simple, several studies show that many aphasic speakers use fewer verbs in spontaneous speech than normal control subjects, that action naming is often more difficult in aphasia than object naming, and that verb inflection is generally problematic in aphasia (cf. e.g. Druks and Carroll (2005) for a recent overview of research on verbs in aphasia). Due to their communicative importance, a natural target for speech and language therapy with a lot of aphasic speakers is an enhanced ability to comprehend and produce verbs in everyday interaction.

In order to facilitate systematic gathering of information about the linguistic abilities of aphasic speakers in relation to verbs and sentences, a test battery known as *Werkwoorden- en Zinnentest* (WEZT) was developed for Dutch (Bastiaanse, Maas and Rispens, 2000). WEZT has since been adapted for English: *The Verb and Sentence Test* (VAST) (Bastiaanse, Edwards and Rispens, 2002) and for Norwegian: *Verb- og setningstesten* (VOST) (Bastiaanse, Lind, Moen and Simonsen, 2006). For all these languages, the test battery has been standardized with non-aphasic adult speakers, and data from aphasic speakers is also provided in the test manuals (cf. also Bastiaanse, Edwards, Maas and Rispens, 2003). In this article, we compare the results of Dutch, English and Norwegian aphasic and non-aphasic speakers on the different subtests of the test battery.

Background

The overall aim of the test battery is to provide clinicians as well as researchers with the opportunity to assess systematically the abilities of aphasic speakers to comprehend and produce verbs and sentences. The test is not meant as a replacement for other aphasia tests or

types of assessment; rather, the intention is that different types of tests and methods of observation should complement each other. The authors of the original Dutch version explicitly state three focal aims of the test battery: a firm theoretical basis in linguistics, usefulness in relation to a wide range of types and degrees of aphasia, and clinical relevance.

The test battery consists of ten subtests in Dutch and English, and eleven in Norwegian. Table 1 gives an overview of the subtests and the number of test items in each of them for the different languages.

Name of subtest	Number of test items
Verb comprehension	60 (Dutch), 40 (English and Norwegian)
Grammaticality judgement	50 (Dutch and Norwegian), 40 (English)
Sentence comprehension	40
Action naming	40
Filling in of infinite verb form	10
Filling in of finite verb form	10
Sentence construction	20
Sentence anagram without pictures	20
Sentence anagram with pictures	20
Wh-anagram (with pictures)	20
Production of past tense form	60 (Norwegian)

Table 1: Subtests and number of test items

Due to structural differences between the languages, the number of test items differs between the languages for the subtest on grammaticality judgement. Here Dutch and Norwegian allow

for interrogative constructions to be included, whereas English does not. The number of test items also differs for the subtest on verb comprehension. This is due to the fact that certain Dutch verbs could not be translated with single verbs into English. These were removed from the test, together with the test items they were matched with, when the English version of the test was made. In the Norwegian version, some of the verbs in this subtest are taken from the Dutch version and some from the English, making sure that the relevant variables (frequency, transitivity and name relatedness with a noun) were controlled for. For practical reasons, it was decided to have the same number of test items in the Norwegian version of this subtest as in the English version, and hence, no new verbs were added for the Norwegian translation.

In clinical practice, the speech and language therapist is not supposed to run through all the subtests with each of his or her clients. Rather, on the basis of observation, other test results etc., assumptions are made concerning the relative strengths and weaknesses of the individual client, and one or more subtests are selected in order to investigate these assumptions more closely.

The additional subtest in VOST allows us to examine the ability of aphasic speakers to produce past tense forms of verbs. It thus adds a particular, but otherwise scarcely covered, focus on verbal inflectional morphology to the test battery. The past tense test was originally developed to examine the acquisition of past tense forms in normally developing children (Ragnarsdóttir, Simonsen and Plunkett, 1999), and it has since been used with a range of other types of informants, including SLI-children (Simonsen and Bjerkan, 1998; Bjerkan, 2000), aphasic speakers (Simonsen and Lind, 2002; Lind, Moen and Simonsen, (in press)), Alzheimer patients (Simonsen, Moen, Øksengård and Engedal, 2004) and Russian learners of Norwegian as a second language (Tkachenko and Simonsen, 2005). Comparative pilot studies of Alzheimer patients and aphasic speakers (Simonsen *et al.*, 2004; Lind *et al.*, (in press)) have given some interesting results in relation to differential diagnosis and to knowledge

about impaired and non-impaired inflectional morphology in these two clinical population groups.

Research questions, data, methodology

Based on the inclusion of the additional subtest in VOST, we have three questions. Firstly, we examine the ability of a group of Norwegian aphasic speakers to access and process past tense forms of verbs in an experimental context. Secondly, we look at the correlations between the results on the past tense test and the other tests for Norwegian aphasics. And finally, we examine the similarities and differences on the test results of aphasic and non-aphasic speakers in Dutch, English and Norwegian.

Our analysis is based on the results obtained for normal control subjects and aphasic speakers in the standardization of each language version of the test. For English and Norwegian, not all informants were tested with each subtest. The results we present are mean percentages for each group. Among the aphasic speakers there is extensive individual variation in all the languages. With a couple of exceptions, we will not, however, go into individual cases in any great detail. Table 2 presents the total and minimum number of informants (aphasics and normal control subjects) for the different language versions of the test.

	Normal controls	Aphasics
Dutch	40	35
English	79 (minimum 20)	25 (minimum 16)
Norwegian	64 (minimum 41)	27 (minimum 15)

Table 2: Total and minimum number of informants

The capacity for processing of inflectional morphology in Norwegian aphasic speakers

In Norwegian, there are three main classes of verbs: a small class of strong (irregular) verbs (about 4 % of the verbs) and two classes of weak (regular) verbs: the large weak class (56 % of the verbs) and the small weak class (40 % of the verbs). The strong verbs have vowel alternations between different forms in the paradigm and past tense is formed without a syllabic suffix. The weak verbs have different syllabic suffixes in the past tense. What particular suffix a weak verb takes, is determined by sociolinguistic factors in the large weak class and by phonological factors in the small weak class. Within all the classes there are both high frequency and low frequency verb tokens. For more information about Norwegian verb classes, see Ragnarsdóttir *et al.* (1999); Endresen and Simonsen (2001). In the past tense test, there are 60 verbs: 27 strong verbs, 16 verbs from the large weak class and 17 verbs from the small weak class. The verbs are matched for token frequency (cf. Ragnarsdóttir *et al.* (1999) for details on frequency counts).

Figure 1 depicts one of the test items in the past tense test. The subject is presented with a picture of somebody performing an action. The target verb is given in different non-past tense forms, both orally and in writing, and the informant is supposed to produce the past tense form of the verb. For example, in relation to the test item in figure 1, the examiner says: ‘This is a man who runs. He likes to run. He did the same thing yesterday. What did he do? He...?’



løpe ('run')

Figure 1: Test item from the past tense test

As expected, the normal control subjects performed at approximately 100% on this test (the average score is 99 %). When required to respond under time pressure, normal control subjects have an average of 94 % (Simonsen and Bjerkan, 1998).

As part of the standardization of the test, 18 aphasic speakers (eight non-fluent and ten fluent) were tested with the past tense test. As a group, the aphasic speakers have on average 74 % correct responses and thus exhibit clear difficulties with accessing and/or processing past tense forms in the test context. The individual variation is extensive, with a high mean standard deviation (22 %).

All the non-fluent aphasic speakers in our data have difficulties with verb inflection. This also holds true for four of the fluent speakers. The rest (six fluent aphasics) perform within the range of normal variation, and when these are excluded from the group of aphasic speakers, the mean average score is as low as 63 %. The strong verbs are most difficult for the aphasic speakers, as evidenced both in the fact that the aphasics have particular difficulties coming up with the correct past tense form of these verbs, and there are also few

generalisation errors to this class (cf. more on error types below). Table 3 presents the mean percentage of correct responses for the group of 12 aphasic speakers (excluding the six that perform close to normal) on the past tense test as a whole and for each verb class.

	Total score	Strong verbs	Weak large class	Weak small class
Aphasics (n = 12)	63 % (SD: 19 %)	58 % (SD: 22 %)	66 % (SD: 27 %)	67 % (SD: 30 %)

Table 3: Mean percentage of correct responses for aphasics on the past tense test

Examining the distribution of correct responses in relation to token frequency, we see a tendency for high frequency verbs to be somewhat simpler to cope with than low frequency verbs for the aphasic speakers as a group. The relevant figures are an average of 66 % correct responses for high frequency verbs and 59 % correct responses for low frequency verbs. This tendency is particularly evident for the strong verbs and the small class of weak verbs. Token frequency has been shown to influence the response patterns of normally developing children on the past tense test, but it is a factor that gets less important with age. For the adult control group there is no statistically significant effect of token frequency on group level (Simonsen and Bjerkan, 1998). For adult aphasics there is a tendency for token frequency to influence the scores; however, this is merely a descriptive tendency, and the individual variation is extensive.

The most common error type among the aphasic speakers is to respond with a wrong form of the target verb (either the infinitive or the present tense), which probably means that they are merely repeating one of the forms that are given as input in the test context.

Generalisation errors, mainly to the weak classes, are the second most common type. Table 4 gives an overview of how the errors in the aphasia group are divided on different error types.

	Gen > St	Gen > WL	Gen > WS	Wrong form	Wrong verb	Other
Aphasics (n = 12)	1.5 %	9.3 %	10.4 %	60 %	11.5 %	7.3 %

Table 4: Percentage of errors in each error type for the aphasic participants

As mentioned, there is great individual variation within the group of aphasic speakers on the past tense test. Two selected cases will serve to illustrate this. GE is a 46 year old woman with a non-fluent, Broca-type of aphasia as assessed by *Norsk grunntest for afasi (NGA)* (Reinvang and Engvik, 1980), which is the standard Boston-type of assessment of aphasia in Norway. LS is a 71 year old man, whose aphasia is characterised as a Wernicke-type, with fluent speech (according to the NGA). Table 5 presents the test results of GE and LS on the past tense test.

	Total score	Strong verbs	Weak large class	Weak small class
GE	67 %	56 %	50 %	100 %
LS	53 %	52 %	69 %	41 %

Table 5: Test results of GE and LS on the past tense test

GE scores slightly above the average score of aphasic speakers in our study (n = 12) on the test as a whole, whereas LS scores below this average. There are also differences between

these two speakers concerning which verb classes are most difficult for them, e.g. the weak small class is the least problematic class for GE, whereas it is the most difficult one for LS. For the large weak class, there is an opposite, but not as clear, difference.

GE differs from the average results of the aphasic speakers also by having somewhat higher scores on low frequency verbs than on high frequency verbs, particularly evident in relation to the large weak class, with 60 % correct responses for low frequency verbs and 33 % correct responses for high frequency verbs in this class. For LS there is an opposite tendency regarding the influence of token frequency. He has higher scores on high frequency verbs than on low frequency verbs, both for the test as a whole and for each of the verb classes. The tendency is most evident in relation to the two classes of weak verbs.

The error patterns of GE and LS display the individual variation even clearer. GE follows the typical error pattern of the aphasic speakers in general. Her errors mainly consist in a wrong form of the target verb, usually the infinitive form. LS has a completely different error pattern, which in fact is closer to the error pattern of Alzheimer patients on this test (cf. Simonsen *et al.*, 2004; Lind *et al.*, (in press)). He mainly responds with another verb than the target verb, a verb form often inflected for past tense. The verbs he comes up with are usually either semantically or phonologically related to the target, as for instance *se* 'see' for *titte* 'look', *brette* 'put together' for *folde* 'fold', *springe* 'rush' for *løpe* 'run' or *fly* 'fly' for *fryse* 'freeze', *ligge* 'lie' for *le* 'laugh' and *skytte* 'shoot' for *skinne* 'shine'. The second most common error type for both GE and LS is generalisation errors.

We may speculate that these two response and error patterns are indicative of different underlying disorders: a grammatical-morphological disorder in the case of the non-fluent speaker (GE) and a lexico-semantic disorder in the case of the fluent aphasic (LS). However, so far, our data are too limited, both concerning the number of informants and the distribution of informants across aphasia types, to allow for any firmer conclusions to be drawn.

Correlations between the results on the past tense test and the other VOST subtests for Norwegian aphasics

Given the inclusion of the past tense test in VOST, we also examine how the results of the aphasic speakers on the past tense test relate to their results on the other tests in the test battery. Due to the low number of informants, the answer to this question is preliminary. However, certain tendencies appear. The highest correlations, i.e. those that are statistically significant at the 0.01 level, are found between the past tense test and the wh-anagram test and the past tense test and the action naming test.

The correlation between past tense and wh-anagrams we assume are due to the fact that both of these tests focus on linguistic processes that are particularly complex, without necessarily being connected in any way. Earlier studies (Simonsen *et al.*, 2004; Lind *et al.*, (in press)) give us reason to believe that the past tense test may have a potential in relation to differential diagnosis, particularly in distinguishing between non-fluent aphasics with a Broca-type of aphasia and Alzheimer patients, and we suspect that the wh-anagram test could also have this potential.

The correlation between past tense and action naming is also interesting, and we will return to this relation as we look more closely at the similarities and differences between the test results of the aphasic speakers and the normal control subjects in the three languages.

Comparison of test results between Dutch, English and Norwegian

For the normal control subjects, the average scores on each of the subtests in the test battery are generally close to 100 %, as expected. Generally, the mean standard deviations are also low. The variation between the average scores ranges from 96 % to 100 %, with one exception: the sentence construction test, where the average scores range from 82 % correct for the Dutch informants to 95 % for the Norwegian and 99 % for the English. These

differences are probably a result of differences in the scoring procedures. As pointed out in the test manual (Bastiaanse *et al.*, 2002), it does not seem feasible to provide a standard scoring system for this subtest; rather than quantitative data it gives qualitative data.

When testing the normally speaking subjects, no cognitive pressures, such as time limits or additional memory tasks, were put on the informants. The main reason for testing the normal control subjects was to make sure that the subtests were not too difficult for normally functioning adult speakers, as well as to establish a comparative norm for the aphasic speakers.

The average scores of the aphasic speakers show, as expected, greater variation, cf. table 6.

	Dutch	English	Norwegian
Verb comprehension	85 %	87 %	86 %
Grammaticality judgement	78 %	77 %	83 %
Sentence comprehension	71 %	73 %	73 %
Action naming	51 %	55 %	68 %
Filling in with infinite verb form	73 %	65 %	67 %
Filling in with finite verb form	55 %	32 %	70 %
Sentence construction	45 %	53 %	77 %

Sentence anagram without pictures	78 %	76 %	82 %
Sentence anagram with pictures	75 %	70 %	80 %
Wh-anagram (with pictures)	57 %	50 %	60 %

Table 6: Average scores of aphasic speakers

Extensive individual variation is a general feature of aphasia, and in the selection of informants for the standardization of the test battery, there was no systematic control for aphasia type or severity for any of the languages. The generally higher scores of the Norwegian aphasics are thus probably coincidental, at least as far as the majority of the subtests are concerned.

The average scores of the aphasic speakers vary considerably on sentence construction. However, as the results on this subtest are variable also in the normal control groups, we ignore this subtest in the further comparison. This leaves two subtests in which the average scores in the different languages are particularly dissimilar, i.e. action naming and the test in which the informant is supposed to fill in a finite verb form in a sentence frame. Furthermore, the production of wh-interrogatives is particularly difficult in all the three languages. Hence, we focus on these three subtests.

Action naming

In the subtest on action naming, the subject is presented with a picture and asked to describe in one word what is happening in the picture. In all the language versions, this subtest has 40

verbs, controlled for transitivity, frequency and name relatedness with a noun. All the verbs are agentive.

On action naming, the scores of the Dutch and the English aphasic speakers are almost equal, with an average of 51 % and 55 % correct responses, respectively. The Norwegian aphasics have a higher average score on this subtest (68 %). This may of course be a coincidental consequence of the selection of informants. Generally low scores on this subtest are not unexpected as anomia is a general characteristic feature of aphasia.

However, the results on action naming may not be caused only by word finding difficulties. Druks and Carroll (2005) suggest that a lack of verbs is due to a combination of lexical retrieval problems and tense deficits. In the Dutch and Norwegian versions, the target verb is the infinitive form, whereas in English, the target is the progressive. None of these forms are inflected for tense. However, in the Norwegian data, we see a tendency in quite a few speakers to respond with a present tense form of the verb, which may suggest that lexical retrieval of a verb for a number of aphasic speakers is closely connected to inflectional processing or accessing. This could also account for the strong correlation between the past tense test and the action naming test that we have seen for Norwegian aphasic speakers.

Filling in a finite verb form in sentences

The subtest in which the informant is supposed to retrieve and produce a finite verb form to fit into a given sentence frame, is the one in which the differences between the average scores of the aphasic speakers are most obvious. In this subtest, the subject is presented with a picture which has a printed sentence underneath. In the sentence the verb is absent and represented by three dots. The experimenter reads the sentence aloud and ‘hums’ three syllables at the place of the verb. The subject is asked to say the missing word. There are ten sentences in all the language versions of this subtest, and the verbs are controlled for frequency and transitivity.

The English aphasics have a particular low average score on this subtest (32 %), whereas the Norwegians have on average 70 % correct responses. The Dutch aphasic speakers perform in between, with an average of 55 % correct responses (cf. also Bastiaanse and Edwards (2004) on production of finite and infinite verb forms).

We suspect that structural differences between the three languages, both in morphology and syntax, may influence the different average scores in relation to this test. In Dutch and English, the finite verb form is inflected for both tense and agreement, whereas in Norwegian, there is no inflection for agreement. In this respect, the morphological system in Norwegian is simpler, and hence may be easier to cope with for aphasic speakers, than that in Dutch and English. The placement of the finite verb in the sentence also varies between these languages. In Dutch the verb is in different positions depending on the sentence type, whereas the variation is considerably smaller in English and Norwegian.

However, it is not the Dutch but the English aphasic speakers who have the lowest average score on this subtest. According to the English test manual (Bastiaanse *et al.*, 2002), the informants are required to respond with a single word in this test, e.g. ‘smokes’ in response to a drawing of a man smoking a pipe. However, in English, the progressive (‘is smoking’) is the citation form of the verb, and it is the form that is presumably more easily triggered in the test context. From other studies (e.g. Druks and Carroll, 2005), we know that tense may be a particularly vulnerable feature in English aphasic speakers with grammatical deficits, and that the progressive is often overused. This may account for some of the discrepancies between the average scores on this subtest.

Production of wh-interrogatives by means of sentence anagram cards

The production of interrogative constructions, such as wh-questions, are often difficult for aphasic speakers (Thompson, Shapiro, Tait, Jacobs and Schneider, 1996), and as noted in the

test manual (Bastiaanse *et al.*, 2002), this is a difficulty which directly interferes with the communicative ability of aphasic speakers in daily life. Prior to the publication of the Dutch original version of the test battery, there was no published test available that allowed the clinician or the researcher to investigate the ability to produce wh-questions. Such a test was therefore developed as part of the test battery.

The test is constructed as a sentence anagram task, where the subject is presented with a picture and a set of word cards and asked to use the cards to form a question that will match the picture. In this way, wh-questions can be elicited in a systematic and structured manner. Two types of questions are elicited: questions where the wh-word represents an NP (*who*, *what*) and questions where the wh-word represents a PP (*where*, *when*). There are five test items for each of these wh-words, altogether twenty test items in each of the language versions.

This subtest is difficult for aphasic speakers in all the languages, but even more so for the English aphasics than for the Dutch and Norwegian subjects. The English aphasic informants have on average 50 % correct responses, whereas the Dutch have 57 % correct responses, and the Norwegians score on average 60 % correct. Syntactic differences between the languages may be one reason for these differences in average scores. In English interrogatives, the verb phrase is more complex than it is in Dutch and Norwegian. So the English aphasics have to deal with five different word cards, whereas the Dutch and Norwegian aphasics only have to keep track of four constituents.

Concluding remarks

In conclusion, we see that overall there is extensive similarity between the test results of Dutch, English and Norwegian aphasic speakers on *The Verb and Sentence Test*. This becomes particularly evident if we exclude two of the more problematic tests, sentence

construction and filling in of finite verb form. We have discussed some possible explanations for the differences found in connection with these tests, related both to structural differences between the languages and to coincidental aspects of informant selection and scoring procedures. The great similarity between the test results in the different languages, as well as the fact that for all the language versions the group of aphasic speakers score significantly lower on all the subtests than the normal control subjects (cf. the test manuals for statistics), suggest that the test battery is indeed sensitive in relation to the specific linguistic difficulties of aphasic speakers. The test battery also seems to be sensitive in relation to a wide range of types of aphasia, even though the individual variation is extensive, as illustrated by the two case descriptions above.

We have also discussed the contribution that the past tense test makes to the Norwegian data, and since inflectional verbal morphology is scarcely treated in the rest of the test battery, we believe that the inclusion of this test in the Norwegian version is useful both for clinical and research purposes. A comparable past tense test would be a welcome addition to the English and Dutch test batteries.

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