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Marianne Lind*, Inger Moen** and Hanne Gram Simonsen**
**Bredtvet Resource Centre, **Department of Linguistics and Scandinavian Studies,
University of Oslo*

Syntactic frames and slot fillers in fluent aphasic speech production: two Norwegian case studies

Introduction

How do speakers with fluent aphasia adapt strategically to difficulties caused by anomia in their speech production? And how does their linguistic behaviour inform our knowledge of the general structure and processing of the mental lexicon? In the present study, we analyse aspects of the language production of two native Norwegians with fluent aphasia, discussing how the data fit in with a heterogeneous network model of the mental lexicon.

1. The mental lexicon

The mental lexicon is the speaker's mental storage of lexical units that are used in language processing. Overall, there are two main theoretical positions concerning the content and structure of the lexicon: a formalist and a functionalist conception (e.g. Bybee 2007:167f). In formalist conceptions, as for instance in generative-grammatical models, the mental lexicon is assumed to be organized in a maximally economic way, implying relatively few stored forms (mainly base forms and irregular forms) and a greater reliance on symbolic rules to generate or process non-stored (regular) forms. Functionalist conceptions, as for instance in cognitive-linguistic models, see the mental lexicon as far more heterogeneous, implying that it consists of many and different types of stored units (words, morphemes, inflected forms, fixed expressions, constructions with open slots for exchangeable items etc.). A form may also be stored more than once, e.g. as a root form, as an inflected form and as part of a fixed expression. Furthermore, the mental lexicon has a network structure where the stored items are connected via at least semantic and phonological pathways. Frequency is a key factor contributing to what is being stored and how it is represented in the lexicon, and this again will affect how rapidly the speaker is able to access it. In the present study, we examine our data in light of a heterogeneous network model of the mental lexicon (cf. Laine & Martin 2006:3f).

For a cognitive-linguistic model of the mental lexicon, it is highly relevant to look at what is known about the brain's capacity for storage and processing, and furthermore, to examine the general basis for linguistic frequency effects (Bybee 2007). The capacity for storage in the human brain is enormous. The adult human brain has around 100 billion neurons with thousands of connections to other neurons (Dąbrowska 2004:17). This capacity for storage is far more impressive than the brain's capacity for processing. Modern desktop computers are for instance one million times faster than the human brain (loc.cit.). There is also a very real basis for linguistic frequency effects. It has been estimated that with an 8-hour "language day" (including all forms of language processing) an individual language user processes more than half a million words each week (Dąbrowska 2004:19). We practically "drown" in language every day from an early stage throughout our lives.

2. Subjects, data and research questions

Our subjects are two native Norwegian males. We call them V and A, respectively. The data on V was collected 15-20 years ago, at which time V was a middle-aged lawyer who had acquired aphasia, apparently without any type of paralysis, as a result of a stroke (Moen 1993). At the time of data collection, V was living at home with his wife and receiving language therapy at a local speech clinic. Based on the recordings of language data, V's speech can be characterised as fluent without any traces of dysarthria. He has occasional phonemic substitutions. His everyday communicative abilities are described as good by his speech and language therapist, and his auditory comprehension on the whole as quite good. There are no results from formal testing of comprehension available for him. His reading abilities are apparently quite good; he is able to read newspaper articles and give summaries of what he has read. Although concerned about his own language difficulties, he does not always seem to be aware of his own language deficits. He rarely makes attempts at self repair in conversation.

The data on A was collected about two years ago, at which time A was 59 years old. He has higher education and has mastered several languages. He acquired aphasia as a result of a stroke at the age of 58. There are no apparent signs of paralysis. At the time of data collection he was living at home with his wife and receiving language therapy. His speech can be characterised as fluent with no traces of dysarthria or apraxia of speech. There are no phonemic substitutions in his speech. He gives the impression of functioning well in everyday communication. However, the responses given by his wife regarding his communicative abilities (the Norwegian version of *The Communicative Effectiveness Index*) (Haaland-Johansen *et al.* 2006)) reveal substantial and real difficulties with everyday communication (total score: 43; max. score: 100). There are few attempts at self correction or meta-communicative remarks relating to his language difficulties in conversation, indicating a somewhat limited awareness of his language deficits.

A has also been tested formally on a range of tests, revealing difficulties with sentence comprehension and comprehension of prepositions (expressing locative relations), but not with lexical comprehension of verbs and nouns. Furthermore, he seems to have an unstable semantic access, difficulties with writing and written naming, difficulties with accessing letters of the alphabet in different modalities and with comprehending the precise meaning of what he is reading. In addition to informal assessment (not based on standardised tests), various subtests from the following test batteries were used: *Verb- og setningstesten* (Bastiaanse *et al.* 2006), *Psycholinguistic Assessments of Language Processing in Aphasia* (Kay *et al.* 1992, Norwegian version, in preparation), *Pyramide- og palmetesten* (Howard & Patterson 2005), *Alfabetprøve* (Corneliussen 2003).

For both V and A anomia is a prominent feature of their disorders, and they solve this problem of word finding using several and different strategies that are observable in their speech production. Among these strategies are lexical paraphrases and lexical substitutions, often semantically related to the presumable target word. In addition, both V and A use a limited set of syntactic frames and a limited set of lexical constructions (words and multiword expressions) more frequently than expected. Finally, they both perseverate on lexical and syntactic material. In this article, we focus on these three last types of strategies: use of a limited set of syntactic frames, lexical overuse and perseveration.

The investigation of these strategies is based on audio recorded speech production in different kinds of contexts. For V we have recordings of informal conversations between him and his speech and language therapist, and recordings of his performance in more structured assessment contexts where he is responding to an object naming task and explaining the meaning of certain words. In total, the data with V amounts to approximately one hour of recorded data (cf. Moen 1993). For A we have an audio recording of his description of the "Cookie Theft", the well known line drawing from the *Boston Diagnostic Aphasia Test* (Goodglass and Kaplan 1972). In total, A produces about 560 word forms in his description of this picture, which is close to three times as many word forms as a couple of normal controls produce (Lind *et al.* 2007).

On the basis of the recorded language data from our two subjects we pose the following research questions:

1. How can we explain three of the strategies that V and A use to cope with the problem of anomia (use of a limited set of syntactic frames, lexical overuse and perseveration)?
2. What is the role of frequency and semantic specificity for the overuse of certain syntactic frames and lexical constructions?
3. How do these strategies fit in with a heterogeneous network model of the mental lexicon?

We also make a set of assumptions in relation to the research questions. Firstly, we assume that in general the use of highly entrenched and frequent words and constructions make language production easier, as it diminishes the processing costs. Secondly, we assume that the use of words and expressions with a general semantic meaning contributes to the same effect: less problematic language production. And finally, we assume that when for some reason there is a word finding problem – when a word form is not adequately activated – it is easier to use words and expressions that have already been activated, resulting in verbal perseverations.

3. Syntactic frames: The presentation construction in the speech production of V and A

Both V and A use variants of the presentation construction extensively in their speech production, realised as *det er* ‘it/there is’ + NP. The noun phrase often contains a determiner, and it may contain an adjective complement. The construction may also be realised in the past tense (*det var* ‘it/there was’). Some examples of this construction in the data are given in (1).

(1)	
<i>det er en ting</i>	‘it is a thing’ (V)
<i>det var en hest ja</i>	‘it was a horse yes’ (V)
<i>det er en kone</i>	‘it is a woman’ (A)
<i>det er to persona</i>	‘there are two persons’ (A)
<i>det er en er en er en serviett eller tilsvarende</i>	‘it is a is a is a is a napkin or likewise’
(A)	
<i>det er et eget skuespill</i>	‘it is a special play’ (V)
<i>det er et kraftig ungt spiker</i>	‘it is a strong young nail’ (V)
<i>det er et kort kvitt bilde</i>	‘it is a short white picture’ (A)
<i>det er et fryktelig brak</i>	‘it is a terrible noise’ (A)

To get an impression of the general frequency of this syntactic construction we have looked at a corpus of spoken Norwegian (NoTa-Oslo)² established at the Text Laboratory, University of Oslo. This corpus consists of interviews and conversations with 166 speakers, and in total it comprises approximately 900 000 words. The varieties of Norwegian represented in this corpus are mainly close to the East Norwegian standard (Røyneland, in press). In a smaller part of this corpus, which was tagged for word class (approx. 78 000 words), pronouns are ten times as frequent as nouns in subject position. More than 1/3 of all pronouns are the word *det* ‘it’, and approximately 10 % of all constructions with pronouns are *det er*-constructions (‘it is’). We may conclude that we are dealing with a frequent construction. We also know that the presentation construction is acquired early by normally developing children (Westergaard 2005:229), thus, all the more reason to assume a solid entrenchment of this construction.

² <http://www.tekstlab.uio.no/nota/oslo/index.html>

In our data, the use of the presentation construction seems to some extent to be dependent upon the discourse context. The construction is used more frequently in the structured or semi-structured test contexts and less often in the conversational data with V. In the test contexts, however, this type of construction is used extensively by our subjects, and far more often than what we have observed in normally speaking subjects in similar contexts. For the Cookie Theft description comparable data from two Norwegian males with no known speech or language disorders illustrate the striking difference in frequency of this construction. In his description of the Cookie Theft, A uses the presentation construction more than seven times as often as either of the two controls. In other words, the presentation construction seems to be strongly entrenched in our two aphasic subjects. Frequent constructions, being well entrenched, are readily available for use in language production, and importantly, due to the diminished processing capacity of aphasic speakers, we expect frequent constructions to be used even more frequently in aphasic language production than in non-aphasic language production.

4. Slot fillers: Words and multiword expressions in the speech production of V and A

Both V and A use some lexical constructions (words and multiword expressions) more frequently than expected, and often these occur in unusual contexts. V uses two adjectives and three nouns frequently. The adjectives are *alminnelig* ‘common, ordinary’ and *egen/eget*³ ‘own, special’. In our data, V hardly uses any other adjectives than these two, and they always occur as modifiers in noun phrases. It is worth noticing that these adjectives are more or less opposite in meaning, which makes good sense from an interactional point of view as well as in an internal cognitive perspective. In (2) and (3) examples are given of V’s use of these adjectives.

(2) (Describing how he got to the speech and language therapist’s office)

Gikk først en ganske alminnelig tid et stykke nedover

‘Went first for a quite ordinary time part of the way down’

(3) (Explaining the meaning of the word *bru* ‘bridge’)

Det er en ting som vil bringe folk tvers over et eget elv

‘It is a thing that will bring people across a special river’

In both of these utterances the adjectives occur correctly in adjective slots. These adjectives are both semantically quite general and can be used in a variety of contexts. However, in the contexts that V uses them, they are unusual and, in the last example, semantically unacceptable.

³ In Norwegian, adjectives are inflected for gender in concord with the head noun in the phrase, thus, *egen* is the common form and *eget* is the neuter form.

V also uses three nouns rather frequently. The first noun – *ting* ‘thing’ – is another word of general meaning usable in a lot of contexts. Again, V uses this word more frequently and in more contexts than normally expected, cf. example (4).

(4) (Explaining the meaning of the word *returnere* ‘return’ (verb))

Man vil returnere den tingen som i sin tid gav oss tingen

‘You will return the thing which in its time gave us the thing’

The two other nouns that V uses a lot – *skuespill* ‘play (at the theatre)’ and *skuespiller* ‘actor’ – are rather idiosyncratic for him. None of these words have a general meaning, and there is a limited set of contexts that they fit into, but V uses them both frequently and in unusual contexts, more or less as noun substitutes or slot fillers. The utterances in (5) and (6) illustrate his use of these words.

(5) (Talking about safety precautions for tourists in the mountains in winter)

Skuespilleren var at hvis det ble et skuespill så skulle de grave seg ned

‘The actor was that if there was a play they should dig a shelter’

(6) (Describing how he got to the speech and language therapist’s office)

Jeg kom ned på skuespilleren langs veien

‘I came down on the actor along the road’

V kept using these idiosyncratic slot fillers in his conversations for several weeks. The first time they appeared, was following a discussion of a recent bank robbery in Stockholm, where a number of hostages had been taken. This incidence was reported broadly in the media, and the therapist used the word *drama* about it. V then started using the word *skuespill* ‘play’ about the event and *skuespiller* ‘actor’ about the persons involved.

Our second subject, A, also has some favourite words and expressions. He uses the verb *komme* ‘come’ frequently. It is the second most frequent verb in his description of the Cookie Theft. *Komme* is a highly polysemous word⁴ with a general semantic meaning and a potential for usage in a wide variety of contexts, although not normally in all the types of contexts in which A uses it. In (7) two utterances exemplifying his use of this verb are provided.

(7) (Cookie Theft description)

Ho som kjeme og stirra tomt inn i vinduet

‘She who comes and stares empty into the window’

Og samtidig nokre trær som kjem i nærheten

‘And at the same time some trees that come nearby’

⁴ In two of the main Norwegian dictionaries (*Bokmålsordboka* and *Nynorskordboka*), eight and ten main, but related meanings are listed for *komme* ‘come’, respectively (<http://www.dokpro.uio.no/ordboksoek.html>).

A also uses quite a few fixed multiword phrases in his speech, such as *eller tilsvarende* ‘or likewise’, *på godt og vondt* ‘for good and for bad’ and *kan du seie* ‘you might say’, all exemplified in (8). Such fixed multiword expressions are often rather general in meaning and usable in a lot of contexts.

(8) (Cookie Theft description)

Kosten kjeme på godt og vondt slik at han faller der

‘The broom comes for good and for bad so that he falls there’

Det er en reaksjon på godt og vondt kan du seie

‘It is a reaction for good and for bad you might say’

Du kan vel skade noke i og med at du kjeme med ja haudet eller tilsvarende på dørken eller tilsvarende så kan du vel slå deg virkelig gale

‘You may hurt something as you come with yes the head or likewise on the deck or likewise then you may hit yourself really badly’

To get an impression of the general frequencies of the slot fillers that V and A use extensively, we have consulted the spoken language corpus described above. For one of the words, we have also consulted an older, but much smaller spoken language corpus (approx. 200 000 words) (TAUS), also available from the Text Laboratory.⁵ In Table 1, the frequencies of the relevant words and expressions from these corpora are given.

	frequency	rank
<i>ting</i> ‘thing’ (NoTa)	1152	99
<i>skuespill</i> ‘play’ (NoTa)	3	6834
<i>skuespiller</i> ‘actor’ (NoTa)	3	7996
<i>egen</i> ‘special’ (NoTa) common	92	608
<i>eget</i> ‘special’ (NoTa) neuter	59	871
<i>alminnelig</i> ‘common’ (NoTa)	1	24181
<i>alminnelig</i> ‘common’ (TAUS)	32	
<i>kommer</i> ‘come/comes’ (NoTa) present tense	1258	94
<i>på godt og vondt</i> ‘for good and for bad’ (NoTa)	3	
<i>eller tilsvarende</i> ‘or likewise’ (NoTa)	0	
<i>kan du si</i> ‘you might say’ (NoTa)	166	

Table 1. General frequencies for the slot fillers.

Some of the lexical constructions that are used frequently by V and A are also frequent or relatively frequent in the most recent spoken language corpus (NoTa). *Ting* ‘thing’ is for instance the second most frequent noun in this corpus, only beaten by the noun *år* ‘year’.

⁵ <http://www.tekstlab.uio.no/nota/taus/index.html>

Egen/eget ‘own’ are other forms of relatively high frequency. *Alminnelig* ‘common’ is on the other hand a word of very low frequency in the most recent spoken corpus. It is a somewhat old-fashioned word which was slightly more frequent 40 years ago as indicated in the TAUS-corpus.⁶ *Skuespill* ‘play’ and *skuespiller* ‘actor’ are, as expected, low frequency words. The verb *komme* ‘come’ which is used frequently in the present tense by A, is another high frequency word in NoTa.⁷ Among the fixed multiword expressions used by A, only one of them (*kan du si* ‘you might say’) is relatively frequent in the spoken language corpus.

5. Perseveration: a general feature of the speech production of V and A

Due to aphasia, V and A experience severe limitations when accessing their linguistic resources, including their mental lexicons. Both of these speakers are frequently at a loss for words, and they use different strategies to keep the discourse going. The recourse to relatively fixed syntactic frames and lexical slot fillers is evident in the data and has been described above. For both of these speakers their use of the presentation construction and several of the slot fillers may also be interpreted as examples of perseveration.

By perseveration we understand “a phenomenon whereby the subject unintentionally produces or gets stuck on an information unit, a particular linguistic form or action unit, which he/she has previously produced or at some level has heard, i.e. auditorily processed, or seen, i.e., visually processed” (Stark 2007:932). Often perseverations are described as contextually inappropriate (op.cit.:935). Different types of perseverations seem to be indicative of different underlying difficulties (Moses *et al.* 2007), and, although a matter of discussion, recent research points in the direction of deviant activation as the main problem underlying perseveration (Martin & Dell 2007).

Both V and A have lexical perseverations in their speech production.⁸ In the case of V, his perseverative behaviour has been described thoroughly by Moen (1993). His use of the nouns *skuespill* ‘play’ and *skuespiller* ‘actor’ are clear examples of lexical perseverations. These examples are particularly interesting because of the duration of the behaviour. Perseverations are rarely as persistent as in this case where V kept using these words for several weeks (cf. also Stark 2007:935). There are, however, also examples of less persistent types of perseverations in V’s speech production. For instance, in the object naming task, in response to a drawing of a thread, he makes a substitution error

⁶ Today *vanlig*, which also means ‘common’, is the more common word. In the NoTa-corpus, *vanlig* has a frequency of 198 and is ranked as number 347.

⁷ The form used by A, *kjem(e)* (present tense), is a western dialectal form which is also found in the Nynorsk standard. There is no reason, however, to think that this form should be less frequent than its urban dialectal/Bokmål counterpart *kommer*.

⁸ V also has some phonological perseverations (cf. Moen 1993); no such perseverations are observed in A’s speech production.

and produces the semantically related word *bomull* ‘cotton’. This word then forms the basis for perseverative errors on the next couple of pictures in the test.

In A’s speech production there are also some lexical perseverations. The clearest example is the verb form *kjem(e)* ‘come’ (present tense), exemplified in (7) and (8) above. There is also an example of perseveration based on a visually processed concept in A’s description of the Cookie Theft. In the drawing a woman is somewhat absentmindedly doing the dishes, in Norwegian *vaske* or *vaske opp* (lit.: ‘wash/wash up’). A does not use this verb referring to the woman and the actions she is performing, but referring to the two children in the drawing and their actions (attempts at stealing cookies), he produces the utterance in (9).

(9) (Cookie Theft description)

Å ja de derre barna ja, ja eg veit ikkje ka, dei e no dei e no barn flest, dei vaskar no med kaker og ja ja

‘Oh yes those children yes, yes I don’t know what, they are well they are like most children, they wash with cakes and yes yes’

The syntactic frame – the presentation construction – used frequently by both V and A and the fixed multiword expressions that are used frequently by A, may also be interpreted as instances of perseveration, at least if the requirement for contextual appropriateness is loosened somewhat. The presentation construction is a versatile construction, usable in a number of contexts. Likewise, fixed expressions often have general meanings, and hence may be used in an array of contexts. To categorise the use of such constructions and expressions as instances of perseveration is therefore problematic. Nevertheless, it seems to be the case that when other constructions (syntactic or lexical) are not readily available for these speakers – due to their anomia – already activated constructions are available, resulting in perseverations at the lexical as well as at the syntactic level. When these already activated constructions are of a general nature – as is the case with the presentation construction and several of the high frequency words and expressions – they are often contextually appropriate, but nevertheless may also be interpreted as instances of perseverations. Perseveration thus seems to be a rather general feature in the speech production of our two subjects.

6. Conclusion: aphasic language as external evidence for a heterogeneous mental lexicon

At the outset of this study, we assumed that language processing is made easier by the use of high frequency syntactic and lexical constructions and semantically versatile constructions, i.e. words and expressions with a general semantic meaning. By examining the general frequencies of the syntactic frame and the different slot fillers that are used with great frequency and often in unusual contexts by V and A, we see evidence for the role of frequency in speech production. The presentation construction and several of the slot fillers are frequent also in non-aphasic language production.

Furthermore, several of the words and expressions used by V and A have a general semantic meaning, and there is no doubt that they are communicatively useful for these speakers. When a word or an expression has a general semantic meaning or has been semantically weakened it follows that it fits more readily into a variety of contexts. This is precisely what we see happening with the general words (such as *ting* 'thing', *egen/ eget* 'own, special' and *komme* 'come') in our subjects. These words are slot fillers rather than carriers of substantial content in the utterances of these speakers. Several of these general words are frequent in normal language production, whereas others are more idiosyncratic (e.g. *alminnelig* 'common'). This does not mean though that the idiosyncratic forms may not be highly frequent and thereby strongly entrenched for the individual speaker.

At the outset, we also assumed that in some aphasic speakers, anomia may result in lexical perseverations due to a combination of difficulties activating a new lexical item combined with normally functioning levels of deactivation. Our data from two speakers with fluent types of aphasia show evidence for perseveration in relation to anomia.

One of the aims of neurolinguistic investigations is to describe and explain aspects of general language structure and processing in the brain by examining language in the exceptional circumstance of a language deficit (Moen 1995). Using aphasic language as data in neurolinguistic studies, the general assumption is often made that this language disorder does not lead to a total reorganisation of neuropsychological structures, but that only certain structures are damaged. This of course allows one to use aphasic language as a source of external evidence in relation to non-aphasic language processing (Moen 1995).

Given this assumption, we may conclude on the basis of our data that we have neuropsychological evidence for a mental lexicon containing not only morphemes and single words, but also larger constructions. Furthermore, we have evidence that access to the units in the lexicon is influenced partly by frequency, partly by the type of semantic meaning of the word or expression, and finally, that access is also dependent upon normally functioning mechanisms of activation. With these data, the assumption of a heterogeneous mental lexicon organised as a network is strengthened.

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