Grammatical Metaphor, Controlled Language and Machine Translation

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Abstract

It is a general assumption that 1) the readability and clarity of LSP texts written in a controlled language are better than uncontrolled texts and 2) that controlled languages produce better results with machine translation than uncontrolled languages. Controlled languages impose lexical, syntactic and pragmatic restrictions on the writing style of the author. We will focus on syntactic restrictions and investigate whether a writing style in which various forms of grammatical metaphors have been dissolved in order to make the text more accessible to human readers, will in fact make the texts more suitable for MT. The basis of our investigation is a small corpus of English LSP texts that have been evaluated regarding their accessibility and acceptability by human users. The MT-system we will introduce as an additional "user" of the texts is the English-Danish prototype of the Comprendium MT-system.

1   Introduction

It is a general assumption that LSP[1] texts written in a controlled language are clearer and more readable than uncontrolled texts[2]. It is also a general assumption that controlled languages produce better results with MT than uncontrolled languages[3].

As regards the first assumption, to our knowledge, only very few reports[4] on what you may call "usability tests" of controlled languages have been published, although controlled languages are now widely used (Bernth and Gdaniec 2001). So it is interesting to study whether controlled language texts are actually considered more accessible and also acceptable within the genre in question by users or readers[5].

A few years ago, a survey was conducted at the University of Aalborg, Denmark (Lassen 1999, 2002, and 2003), in which the attitudes of different audiences to the accessibility and acceptability of a number of LSP texts, including text versions which may be regarded as controlled-language texts, were investigated.

In our paper, we will investigate whether the controlled-language versions of these test texts are

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[1] Language for Special Purposes (LSP), as opposed to Language for General Purposes (LGP).
[2] See e.g. Arnold et al. 1994; Wojcik and Hoard 1996
[3] See e.g. Arnold et al. 1994.
[4] See e.g. Holmback et al. 1996
[5] See also Huijsen 1998

more suitable for machine translation than the original texts, and whether the text versions preferred by the machine are also the ones preferred by the human users from the survey.

2 The Aalborg survey

In a survey which formed the empirical basis of her ph.d. thesis, Inger Lassen distributed a questionnaire to a variety of professional groups, including technical writers, translators, engineers, technical language instructors and a non-expert group of respondents with mixed occupations, who were unfamiliar with technical writing style. Each respondent was encouraged to state his or her attitude to the accessibility and acceptability[6] of one out of six short texts which appeared in three versions. One version was the original text, the second a text from which grammatical metaphors (see below) had been removed, and the third was a version with short sentences. 195 Danish individuals responded, and 32 British ones.

The texts were extracts from technical manuals for agricultural machines (combines) and for hydraulic systems: user's manuals, repair manuals, training manuals and maintenance manuals. For machine translation, we selected all three versions of two of the texts: a user's manual for a straw walker and a maintenance manual for a cylinder, covering the text types Description and Procedure.

Grammatical metaphor (GM): As Lassen (2002) points out, in technical discourse, the majority of texts are found to be accessible only to a specialist audience. This is due to the conventional technical writing style, which is characterised by a high frequency of passives, nominalizations, definite article omission, non-finite clauses and clusters of nouns. In Systemic Functional Grammar, some of these configurations (nominalizations, nominal groups and non-finite clauses) are referred to as grammatical metaphors. Lassen herself has suggested an extension of the GM-range to include also the passive voice and definite article omission, thus enabling a discussion of characteristic stylistic features in technical discourse under the umbrella of GM.

A grammatical metaphor is the result of a shift between grammatical categories, e.g. where a nominal group is used for the contents of a verbal group, as in the example in Figure 1 below.

The example in Figure 1 is explained like this: "The example shows that in the metaphorical realization, shifts have taken place by which the categories Process, Goal and Circumstance have been mapped onto Actor to form a complex nominal group that – if expanded into a complete sentence – might read: '*The driver's overrapid downhill driving of the bus caused brake failure*.'"

Non-metaphorical realization:			
The driver	*drove*	*the bus*	*too rapidly* *down the hill*
Actor (Subject)	Process (Verb)	Goal (Direct object)	Circumstances of manner and direction (Adverbials of manner and direction)
Metaphorical realisation:			
The driver's overrapid downhill driving of the bus			
Actor (Subject)	Process (Verb)	Goal (Direct object)	Circumstance (Adverbial)
Figure 1: Shifts between grammatical categories resulting in GM[7] (Conventional grammatical designations in brackets)			

[6] In accordance with Klare (1963), Lassen (1999) defines *accessibility* as "Ease of understanding or comprehension due to the style of writing", and *acceptibility* she defines as "The text receiver's attitude in communication when they accept a given language configuration as a cohesive and coherent text capable of utilization".

[7] (Halliday, 1996:5-6), cited in (Lassen 2002).

Lassen (1999:58) has the grammatical metaphors shown in Figure 2 below.

Grammatical Label	Example
Compound nouns	*straw walker rear shaft*
The passive voice	*the grain is moved to the front of the top sieve*
Reference	*Connect [the] pipes to [the] cylinder*
Non-finite clauses (-ing-forms)	*Operate the valve, checking for continuous flow*
Ellipsis	*Cleaning shoe drive belt [is] slipping*

Figure 2: Examples of grammatical metaphors (ellipted words in brackets)

3 Grammatical metaphor and controlled language

The question is whether the changed versions of the test texts can be viewed as controlled language texts. To answer this question, we have to investigate 1) whether the strategies for rephrasing the GMs as outlined above are comparable to controlled language rules and 2) whether the changed versions of the texts contain linguistic structures that do not comply with controlled language rules.

As an example of a controlled language, we have chosen AECMA Simplified English as represented in the Boeing Simplified English Checker[8]. AECMA Simplified English is a writing standard for aerospace maintenance documentation which aims at making maintenance manuals clear and unambiguous for English speakers and non-native English speakers alike. So, it was designed for human readers, and not specifically for machine translation. We have chosen the AECMA SE for our investigation as it is one of the best-known examples of a controlled language. The domain-specific part of the AECMA Simplified English is the vocabulary, whereas the syntactic and pragmatic or stylistic rules are general. As our investigation concerns the syntactic level, we consider it reasonable to use the AECMA SE for comparison.

3.1 Compound nouns

The AECMA SE rule bans noun clusters of more than three words, unless they are Technical Names (i.e. domain-specific terms), in which case they

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[8] BSEC-Checker V2.1.1, see www.boeing.com

should be clarified by means of hyphens connecting the most closely related words and/or by means of an explanation and a short name.

Most of the noun clusters in the test texts have three words, only one has four words. In the changed version of the texts, both three and four word noun clusters have been rewritten by means of an "of"-PP indicating a possessive relationship as in:

```
(1a) GM⁹: the cylinder barrel
surface finish
(1b) CH: the surface finish
of the cylinder barrel
```

or by means of a relative clause as in:

```
(2a) GM: the straw retarding
curtain

(2b) CH: the curtain that re-
tards the straw
```

So, in this respect, the test texts comply with SE rules.

3.2 Definite article omission

According to the AECMA SE rule, an article (the, a, an) or a demonstrative pronoun (this, these) should be used before a noun, when appropriate, in order to show where the noun phrases are. The rule states, however, that articles are not necessary before all nouns in a series or before mass nouns used in general statements.

In the changed test texts, articles left out in the original have been inserted, thus complying with the SE rule:

```
(3a) GM: Leaving the cylinder
in outstroked (+) position,
test _ blank end cover / _
cylinder barrel connection
for leaks by painting with
oil or _ soapy solution.

(3b) CH: Leaving the cylinder
in outstroked (+) position,
test the end cover of the
```

---

[9] GM = Grammatical Metaphor, CH = Changed, i.e. non-metaphorical wording.

```
blank and the connection of
the cylinder barrel for leaks
by painting with oil or a
soapy solution.
```

3.3 Non-finite clauses (–ing-forms)

There is no specific rule in SE forbidding non-finite clauses with –ing-forms. However, there is a rule which has the same effect, namely a rule forbidding verb forms that are not in the lexicon. The following verb forms are allowed: infinitive, imperative, simple present tense, simple past tense, future tense. –ing-forms of verbs are not allowed, unless they are in the lexicon as nouns or adjectives, or they have been added as parts of Technical Names.

In the changed versions of the test texts, potentially ambiguous non-finite clauses with –ing-forms have been rewritten into finite clauses:

```
(4a) GM: The straw walkers
oscillate, lift and tumble
the straw permitting the re-
maining grain to fall through
the walkers and slide down
the walker return pans onto
the rear of the grain pan.
```

```
(4b) CH: The straw walkers
oscillate, lift and tumble
the straw and thereby permit
the remaining grain to fall
through the walkers and slide
down the return pans of the
walker onto the rear of the
grain pan.
```

The –ing-form in (4a) is ambiguous. It may be interpreted paratactically as '*The straw walkers oscillate ... the straw and permit the ... grain to fall through ...*', or hypotactically as '*The straw walkers oscillate ... the straw while they permit the ... grain to fall through ...*', thus stressing the time factor[10]. In the changed version, the paratactical interpretation was chosen, and the adverb '*thereby*' was inserted in order to make the causal relationship explicit.

```
(5a) GM: This increases the
capacity of the cleaning shoe
considerably when operating
in hilly conditions.
```

```
(5b) CH: This increases the
capacity of the cleaning shoe
considerably when you operate
in hilly conditions
```

In (5a), the –ing-form involves a different type of ambiguity, in that it is not clear what the agent of the –ing-form is: 'this' or 'the cleaning shoe' or 'you'[11]. In the changed version, the subject '*you'* is inserted.

However, non-finite –ing-clauses do occur in the changed test texts in two cases:

- when the agent is obvious from the context:

```
(6a) GM: Leaving the cylinder
in outstroked (+) position,
test blank end cover / cylin-
der barrel connection for
leaks by painting with oil or
soapy solution.
```

```
(6b) CH: Leaving the cylinder
in outstroked (+) position,
test the end cover of the
blank and the connection of
the cylinder barrel for leaks
by painting with oil or soapy
solution.
```

In (6a) and (6b), the imperative form '*test*' indicates that the agent is the reader of the manual, i.e. the operator of the machine.

- in headings

```
(7a) GM: Testing the cylinder
```

```
(7b) CH: Testing the cylinder
```

In none of these examples is the –ing-form ambiguous to a human reader, but nevertheless, it breaks the SE rule banning ing-forms.

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[10] cf. Lassen 1999:62, where a different example is used

[11] The latter reading is an example of a 'misrelated' og 'dangling' participle.

3.4 Passive voice

The AECMA SE rule says: Use only the active voice in procedural writing, and as much as possible in descriptive writing.

The changed test texts comply with the SE rule stating that active voice should be preferred. Passive sentences have been rewritten into active sentences with an explicit agent, or in one case into an imperative sentence.

In a few cases the passive has been preserved (indicated by a dotted line):

```
(8a) GM: If air is blowing
continuously out, then either
the piston seal is incor-
rectly assembled or damaged,
or there is a flaw in the
cylinder barrel surface fin-
ish
(8b) CH: If air is blowing
continuously out, then you
have either assembled the
piston seal incorrectly or it
has been damaged, or there is
a flaw in the surface finish
of the cylinder barrel.
```

This is descriptive text, and the agent is unknown – so the passive voice is acceptable according to the SE rule[12].

3.5 Ellipsis

An AECMA SE rule says: Do not omit words to make your sentences shorter. The following specifications are given: Do not omit nouns; the reader will not know what things are referred to (WRITE: *Cracks can be a maximum of five inches long*. NOT: *Can be a maximum of five inches long*). Do not omit verbs; the reader will not know what the action is (WRITE: *Set the rotary switch to INPUT*. NOT: *Rotary switch to INPUT*). Do not use expressions in which the topic item is omitted; the reader will not know what things are referred to (WRITE: *If the shims are installed, remove them*. NOT: *If installed, remove the shims*).

In the test texts, there is only one example of ellipsis, which has been eliminated in the changed version:

```
(9a) GM: It will be necessary
to strip down the cylinder
and examine __ to clear the
fault

(9b) CH: You will have to
strip down the cylinder and
examine it to clear the fault
```

3.6 Short sentences

According to the AECMA SE, sentences should be kept as short as possible (procedural sentences 20 words maximum, descriptive sentences 25 words maximum). In procedural writing, there should only be one instruction per sentence. In descriptive writing, it is recommended to vary sentence lengths and constructions to keep the text interesting, and there should be only one topic per paragraph.

The changed versions of the test texts do not observe this condition, but the changed short (CH-SH) versions where long sentences have been split up, do:

```
(10a) GM: The straw walkers
oscillate, lift and tumble
the straw permitting the re-
maining grain to fall through
the walkers and slide down
the walker return pans onto
the rear of the grain pan.
(Descriptive writing, 32
words)

(10b) CH: The straw walkers
oscillate, lift and tumble
the straw and thereby permit
the remaining grain to fall
through the walkers and slide
down the return pans of the
walker onto the rear of the
grain pan. (Descriptive writ-
ing, 36 words)

(10c) CH-SH: The straw walk-
ers oscillate, lift and tum-
ble the straw. Thereby it
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[12] However, according to the SE rule which states that past participles should only be used as an attributive adjective, or with a form of the verb 'to be' or 'to become', the wording should probably be '*... or it was damaged*'.

```
permits the remaining grain
to fall through the walkers.
From the walkers it slides
down the return pans of the
walker onto the rear of the
grain pan.
```

In conclusion, the changed versions of the test texts comply with the AECMA SE rules, with two exceptions: -ing-forms are used in some contexts which are unambiguous to the human reader, and some sentences are too long in the changed versions, but not in the changed/short versions. In addition, there has been no attempt to define an SE lexicon (one word – one meaning) for the test texts.

4   Machine translation of the text corpus

Will the changed (controlled language) versions produce better results with machine translation than the original versions with grammatical metaphors? In order to answer this question we will examine each of the phenomena outlined above.

4.1   Compound nouns

A compound like *'walker return pan'* is potentially ambiguous: each word may have several different meanings and consequently different translations. In general language, *'walker'* may mean "a person who is walking", whereas in technical language it may be a shortened form of "straw walker".

In a traditional, rule-based machine translation system like the Comprendium system, the user can disambiguate these meanings by placing them in different lexicons within a hierarchy of lexicons. So, the translation of the "straw walker" meaning of *'walker'* may be placed in a mechanical engineering lexicon, or a more specialised lexicon.

Still, if there are several possible translations of the entry in the lexicon chosen, there is no guarantee that the system will select the proper translation when translating the compound compositionally (word by word).

As the correct translation of technical terms is of great importance, one obvious solution will be to enter the compound *'walker return pan'* into the lexicon. From this point of view, a compound of three or more parts is to be preferred to a non-metaphorical, controlled-language rephrasing. So, *'the walker return pans'* is to be preferred to *'the*

return pans of the walker', and *'the straw retarding curtain'* is to be preferred to *'the curtain that retards the straw'*.[13]

There is one case, however, where a rephrasing of the compound is potentially more suitable to machine translation, namely the case where the structure of the target language (TL) equivalent varies according to the linguistic context. A typical example is the translation of an English compound into a Danish genitive construction. This TL structure is possible when there is a definite determiner, but not in other contexts, see example (11a) and (11b) below:

```
(11a)(the) piston rod end
cover
= stempelstangens endedæksel
[of-the-piston-rod end cover]
(Danish genitive)

(11b) (a different) piston
rod end cover
= et andet endedæksel til
stempelstangen
(Danish PP).
```

Here, non-metaphorical rephrasings would be more readily translatable:

```
(12a) the end cover of the
piston rod

(12b) a different end cover
for the piston rod.
```

Conclusion: As far as the MT system is concerned, compound nouns are to be preferred to non-metaphorical rephrasings, in order to secure correct translation of the compound. In cases where the linguistic context requires a rephrasing in the TL, one solution could be to add this information as a feature in the lexicon entry of the Danish equivalent.

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[13] In the test texts, the rephrasing strategy was used. If the compound qualifies as a Technical Name, then, according to the SE rules, it would not have had to be rephrased, but hyphens would have to be inserted in order to clarify the internal relationship to the human reader. This would result in "*straw-retarding curtain*" and "*walker return-pans*".

4.2 Definite article omission

There is a high ambiguity between English nouns and verbs. A traditional rule-based machine translation system like Comprendium lacks the knowledge necessary to choose among the noun and verb readings in the cases where there are no syntactic clues in the sentence to aid disambiguation. So, *'Test the blank end cover for leaks'*, which can only be interpreted as a sentence with *'test'* as the finite verb, is to be preferred to *'Test blank end cover for leaks'* where *'test'* can also be a noun in a compound *'test blank end cover'*, as far as the syntactic parser is concerned.

Conclusion: The non-metaphorical, controlled-language version with determiners before nouns is definitely to be preferred for machine translation purposes.

4.3 Non-finite clauses (-ing-forms)

Non-finite clauses are ambiguous. This ambiguity cannot be transferred to all target languages. E.g. Danish will have to make the relationship between the non-finite clause and the matrix clause explicit. As the examples 4 and 5 above demonstrate, this involves inserting lexical material on the basis of the context, an operation which will often require extralinguistic knowledge not available to the MT system. In addition, -ing-forms which are unambiguous to the human reader may be ambiguous to the MT system. E.g. in example (4a): *'The straw walkers oscillate, lift and tumble the straw permitting the ... grain to fall through ...'*, as far as the system is concerned, the non-finite clause may also be a reduced relative clause defining the noun *'straw'*.[14]

4.4 Passive voice

Some English passives are ambiguous to the MT systems, in that stative and dynamic passives may be difficult to disambiguate, e.g. example 8 above in the SE version: *'... or it was damaged ...'* will have two different translations into Danish, depending on the interpretation chosen.

In general, however, MT systems have no difficulties translating passives, so a controlled-language rule banning passives altogether will per-

haps help the human reader who needs to identify the agent of the sentence, but not the MT system.

4.5 Ellipsis

Analysing and translating elliptic sentences is one of the major problems for an MT system. A controlled-language rule that recommends preserving complements (subject, object etc.) in sentences will definitely help the MT system.

4.6 Short sentences

In general, the performance of MT systems decreases when input sentences exceed 20 to 30 words, so a controlled-language rule banning long sentences will help the MT system. However, when splitting up a long sentence involves introducing pronouns as in example (10c), a new problem is introduced, namely pronoun resolution. Correct identification of the antecedent of a pronoun (number, gender) is necessary to translate the pronoun correctly. As traditional rule-based systems operate on sentence level, they will not be able to recognise an antecedent, which is not in the same sentence as the pronoun in question.

5 Are the versions most suitable for MT also most suitable for human readers?

The second assumption: "controlled languages produce better results with MT than uncontrolled languages" was confirmed when the test texts were machine translated (which is not surprising).

However, the first assumption: "LSP texts written in a controlled language are clearer and more readable than uncontrolled texts" was not fully supported by the Aalborg survey.

In the survey, this aspect is best covered by the investigation of **accessibility** of the different text versions. It turned out that the respondents' preferences were largely determined by their professional occupations (see Appendix A). A relative majority of the two largest groups of respondents, Danish engineers and translators, rejected the changed, controlled-language versions, although it is worth noting that almost as many translators rejected the original version. Interestingly enough, Danish engineers and translators seemed to be more 'conservative' than the British control group, in which a higher percentage found the changed versions more accessible than the original versions.

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[14] Bernth and Gdaniec (2001) has many more examples of problematic –ing-forms and ways of avoiding them (and other linguistic structures that reduce machine translatability of texts).

And similarly, the Danish group of non-experts almost unanimously found the changed versions most accessible.

When asked about their views on specific stylistic realisations, a majority of respondents preferred the passive voice, nominal and impersonal style, premodification, ellipsis and non-finite clauses. There were, however, two exceptions from the norm in that a majority preferred to retain the definite article rather than leaving it out, and not to leave out the object [it] in a sentence like *'it will be necessary to strip down the cylinder and examine [it] to clear the fault.'* (Lassen 1999:124). And, unlike the other groups, the group of non-experts favoured direct, active and personal style (Lassen 1999:176).

The result of this part of the study deviates from e.g. Holmback et al. (1996), whose research showed that Simplified English would improve the comprehensibility of instructional texts. However, the differences in the setup of the two studies make it difficult to compare them. E.g., whereas the Holmback investigation was based on comprehension tests, the Aalborg survey was based on subjective reactions of the respondents to test texts and to sentence pairs designed to check particular linguistic features.

The subjective reactions of readers are important for successful communication, though, and violations of genre conventions may introduce noise into the communication. Therefore also the results regarding **acceptability** of the different text versions are interesting in that the survey showed that all the occupational groups, i.e. both experts and non-experts, preferred the original version as the most acceptable (See Appendix A).

So, judging by the Aalborg survey, it seems that the non-metaphorical writing style favoured by machine translation systems is not the one preferred by human users of the documentation: the majority of expert readers find it neither acceptable nor more accessible than the conventional writing style, and although non-experts find it more accessible, they do not regard it as equally acceptable.

This picture would probably have been even clearer if not only the syntactical but also the lexical restrictions of controlled languages (one word – one meaning) had been implemented in the test texts. As noted by various controlled language writers, lexical restrictions will sometimes result in stilted formulations (e.g., Muldoon 1999).

6 Concluding remarks

When writing documentation and defining stylistic guidelines for an enterprise, it is of course always important to identify the audience of the documentation, but it seems to be even more important if the enterprise considers introducing machine translation in its documentation workflow and introducing a controlled language in order to have the maximum benefit of the MT system. If the audience consists of expert users, the lower acceptability of a non-metaphorical and thus machine-friendly writing style does not seem to be compensated for by higher accessibility of the documentation.

One solution could be to have two different versions of documentation: A version in conventional technical writing style and a controlled-language version adapted for machine translation. This approach will probably only be profitable if the documentation has to be translated into several language pairs.

Another solution may be to seek a compromise between the needs of the human users and the machine translation system in the formulation of the controlled language. Such a controlled language may have rules banning deletion of definite articles and certain kinds of ellipsis and –ing-forms, but may allow passive voice, nominal and impersonal style.

7 Acknowledments

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(http://cslu.cse.ogi.edu/HLTsurvey).

Appendix A. Accessibility and acceptability of test texts 1-6[15]

Preferred versions: Accessibility, texts 1-6, Danish respondents		
Original:	82 of 195	42.1%
Changed.	41 of 195	21.0%
Short sentences:	68 of 195	34.9%
No version preferred:	(NA/no answer)	2.0%

Table 1

Preferred versions broken down on occupational groups: accessibility (texts 1-6)

Occup.	a)	b)	c)	d)	e)	f)	g)	h)	Total
Original	2 (23)	**28 (47)**	24 (39)	**5 (42)**	7 (32)	5 (38)	**5 (71)**	**5 (45)**	81
Changed	3 (33)	14 (23)	9 (15)	3 (25)	**10 (45)**	0	0	2 (18)	41
Short	**4 (44)**	17 (28)	**28 (46)**	4 (33)	4 (18)	**7 (54)**	2 (29)	2 (18)	68
NA	0 (0)	1 (2)	0	0	1 (5)	1 (8)	0	2 (18)	5
Total	9	60	61	12	22	13	7	11	195

Table 2 – (preferred versions in bold) (n = 195)

a) Technical English instructor
b) Engineer/technician
c) Translator/technical writer
d) Executive responsible for the design of technical manuals
e) A mixed group of other occupations
f) Engineer and executive
g) Translator and executive
h) NA and other combinations

Preferred versions: Acceptability, texts 1-6, Danish respondents		
Original:	99 of 195	51%
Changed:	38 of 195	19%
Short sentences:	47 of 195	24%
No version preferred:		6%

Table 3

Preferred versions broken down on occupational groups: acceptability (texts 1-6)

Occup.	a)	b)	c)	d)	e)	f)	g)	h)	Total
Original	**6 (67)**	**25 (42)**	**34 (56)**	**7 (54)**	**9 (39)**	**6 (46)**	**5 (83)**	**7 (70)**	99
Changed	1 (11)	16 (27)	11 (18)	3 (23)	5 (22)	0	0	2 (20)	38
Short	2 (22)	16 (27)	13 (21)	2 (15)	6 (26)	6 (46)	1 (17)	0	46
NA	0	3 (5)	3 (5)	1 (8)	3 (13)	1 (8)	0	1 (10)	12
Total	9	60	61	13	23	13	6	10	195

Table 4 (preferred versions in bold)

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[15] Source: Lassen 2002 / Lassen 1999: 96, 100, 106, 108