An HPSG account for German numeral classifiers

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1 Introduction

In contrast to languages with rich classifier systems, such as Chinese, German would not be considered as a numeral classifier language. But indeed there are elements in German that can be considered as numeral classifiers such as *Stück* 'sortal classifier (SCL)' and research on it has been relatively marginal. However, the rich variation in German w.r.t. declension also offers an interesting perspective on the study of classifiers.

This paper focuses on German numeral classifier phrases and provides an HPSG analysis for their morphosyntax and semantics. Due to the different properties of *ein-* 'one' and other numerals (Num[1]), the analyses of classifier phrases will be discussed separately. On this basis, the combination of determiners and classifiers is also taken into account.

2 Classifiers and *nouny* nouns

A noun phrase consisting of three members (a numeral, a noun (N1) used as a unit of measurement or counting, and another noun (N2) being measured or counted) is known as a numerative construction (Krifka 1991: 401). Based on the semantic contribution of N1 they can be further divided into six subcategories such as measuring constructions (*Liter* 'liter'), container constructions (*Becher* 'cup'). Interested readers are referred to Gunkel et al. (2017: 1702) for a detailed taxonomy. In this paper, I treat N1 that do not contribute their own semantic content as sortal classifiers (see *Stück* 'SCL' in (1a)), and all other types of N1 are considered as measure classifiers (MCL, represented by *Scheibe* 'slice' in (1b)).
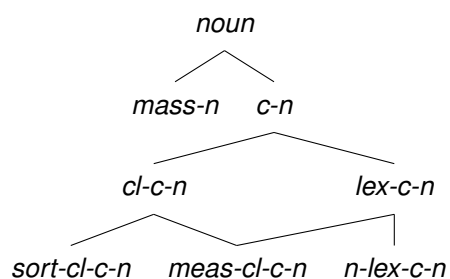
(1) a. zwei Stück$_{N1}$ Vieh$_{N2}$
         two SCL   cattle
         'two heads of cattle'

     b. zwei Scheibe-n$_{N1}$ Brot$_{N2}$
         two   slice.MCL-PL bread
         'two slices of bread'

In addition to the semantic differences, the immediate morphosyntactic difference between (1a) and (1b) is that there is no morphological change[2] in SCL, even though *Stück* 'SCL' itself has its plural form *Stücke* 'SCL.PL', and *Scheibe* 'slice.MCL' retains its marking as a count noun. Arguably, the nouns *Stück* 'SCL' and *Scheibe* 'slice.MCL', both of which have grammatical gender and can be employed as classifiers, are located at different stages of grammaticalization. Since the lexical meaning of MCL is more pronounced, any MCL i.e. a measure-classifier-noun is also a lexical count noun.

(2) a. das Stück Vieh
         the SCL   cattle
         'the head of cattle'

     b. die Scheibe   Brot
         the slice.MCL bread
         'the slice of bread'

(3) zwei Tisch-e
     two   table-PL
     'two tables'

(4) Hierarchy of nominal HEAD values

```
                    noun
                    /\
            mass-n      c-n
                       /\
                  cl-c-n      lex-c-n
                  /\            |
        sort-cl-c-n  meas-cl-c-n  n-lex-c-n
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German distinguishes between count and mass nouns. In general, only mass nouns need to be made 'countable' with the help of other elements, i.e. classifiers in this study, when expressing a quantitative

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[1]The following abbreviations are also used in the paper: N/n=noun, Mod=modifier, CL/cl=classifier, MCL= measure classifier, PL=plural, c-n=count noun, DAT=dative, SG=singular, G(EN)=genitive, WK=weak, PST=past, AKK=akkusative, NOM=nominative, ST=strong, NEU=neutral, Det=determiner.

[2]As one reviewer pointed out, while *zwei Stücke Vieh* 'two SCL cattle' is possible, *Stück* 'SCL' here is not functioning as a classifier but rather as part of a partitive construction. Due to space constraints, this article focuses exclusively on classifiers.

meaning, since count nouns (3) can be used directly in conjunction with numerals. Therefore it is not surprising that in (1) N2 are nouns without plural inflection[3]. Combining the count/mass distinction and classifiers, I assume a hierarchy of nominal HEAD values in (4): *Vieh* 'cattle', *Stück* 'SCL', *Scheibe* 'slice.MCL' and *Tisch* 'table' have the HEAD values of *mass-n*, *sort-cl-c-n* (sortal-classifier-count-noun), *meas-cl-c-n* (measure-classifier-count-noun), and *n-lex-c-n* (nouny-lexical-count-noun) respectively. Only *cl-c-n* can make *mass-n* occur in a numerative construction.

2.1 Combining N1 and N2

So far I've only mentioned the case where N1 and N2 are juxtaposed (Kobele & Zimmermann 2012: 265), meaning that N1 and N2 have the same case inflection (5a). But there are actually some MCL that allow N2 to be combined with it in genitive case (5b) or with the aid of a preposition *von* 'of' (5c), in other words, N2 is N1's attribute. Considering the other semantic components brought by (5b) and (5c) (Löbel 1986: 77-87), in this paper, I follow Krifka (1989: 15), limiting myself to the appositive structure (5a) that is more focused on the function of quantitative information.

(5) a. mit zwei Scheibe-n   köstlich-em   Brot
         with two   slice.MCL-PL.DAT delicious-SG.DAT bread

         'with two slices of delicious bread'

     b. zwei Scheibe-n   köstlich-en   Brot-es
         two   slice.MCL-PL delicious-SG.GEN bread-SG.GEN

         'two slices of delicious bread'

     c. zwei Scheibe-n   von diesem köstlich-en   Brot
         two   slice.MCL-PL of   this.DAT delicious-DAT.WK bread

         ' two slices of this delicious bread'

2.2 Headedness of a classifier phrase

Since N1 and N2 are combined juxtaposed, this inevitably brings up the discussion of the headedness of a classifier phrase, that is an NP. The case of MCL like *Scheibe* 'slice.MCL' is more straightforward, since the verb and *Scheibe* 'slice.MCL' (the subject) agree in number, that is plural in (6a).

As for SCLs, since the more functional *Stück* 'SCL' has no alternative morphological inflection, (6b) can't provide positive evidence for which N is the head. But it is still reasonable to treat SCLs also as the head of the classifier phrase. The NUM value of *Stück* 'SCL' can be *sg* ∨ *pl*, so that *Stück* 'SCL' is allowed to be combined with a numeral that is other than one.

The alternative, where *Vieh* 'cattle' is the head of the NP, is even less plausible. If that were the case, one would have to make a mass noun open to the numerals, which is subversive to the basic logic of German grammar: only count nouns can be used directly with numerals. In our case, *cl-c-c* is a subtype of count nouns, so *Stück* 'SCL' can be the head of the NP and all is safe.

(6) a. Auf dem   Teller der   Frau lieg-en zwei kleingeschnitten-e   Scheibe-n   Brot
         one the.DAT plate the.GEN woman lie-PL   two   chopped-NOM.WEAK slice.MCL-PL bread

         'On the woman's plate are two slices of bread that have been cut into small pieces.'
                                                      (Braunschweiger Zeitung, 21.05.2010, DeReKo-example)
     b. 1955 kam-en   0,82 Stück Vieh auf einen   Einwohner
         1995 come.PST-PL 0.82 SCL   cattle on one.AKK inhabitant

         'In 1955, there were 0.82 head of cattle per inhabitant.'
                                                          (St. Galler Tagblatt, 24.01.1998, DeReKo-example)

Thus, morphosyntactically, the classifier is always the head of the German classifier phrase (NP). But semantically there is a problem that requires attention. There are examples in the DeReKo (*Das Deutsche Referenzkorpus* 'The German reference corpus') where *Stück* 'SCL' can be preceded by

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[3]Indeed, the number of N2 varies according to the detailed subtypes of the classifier's have. In the case of measuring structures, counting constructions, and classifier constructions (Krifka 1989: 12), N2 must be a mass noun, but the HEAD value of N2 is underspecified in the case of container constructions and collective constructions. The same is true for the number of N1 mentioned before. In this abstract, for space reasons, I treat *Scheibe* 'slice.MCL' as a representative of MCL, taking into account the semantic differences between SCL and MCL.
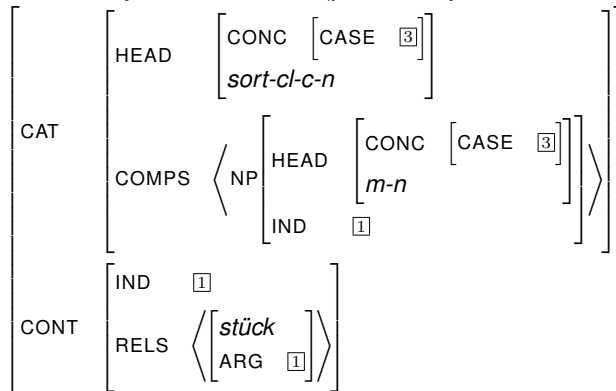
adjectives modifying N2, see (8). As a SCL, *Stück* does not provide an extra lexical contribution, and it's only the *Vieh* 'cattle' that gets sick or dies[4]. If *Stück* 'SCL' is the head, then this semantic connection of modifiers preceding the classifier and N2 needs to be possible. This can be regarded as a special feature of sortal classifiers as "functional" nouns: In CONT (9a), a SCL takes the IND of N2 as its argument and shares the IND of N2. If there is an adjective modifying N1, it still modifies the IND of N2[5]. This is an important difference between SCL and MCL. A MCL will also take the IND of N2 as the argument of for instance *scheibe-rel* (9b), but it still has its own distinct IND that can be modified by other adjectives, such as *kleingeschnitten* 'chopped' in (6a).

(8) a. ein tot-es   Stück Vieh
     one dead-ST.NOM/AKK.NEU SCL   cattle

     'a dead head of cattle'   (Neue Zürcher Zeitung, 29.05.2004, DeReKo-example)

     b. ein-em   krank-en   Stück Vieh
        one-DAT.NEU sick-WK.DAT SCL   cattle

        'a sick head of cattle.'   (die tageszeitung, 02.10.2009, DeReKo-example)

(9) a.
$$\left[\text{CONT} \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RELS} & \left\langle \begin{bmatrix} stück\text{-}rel \\ \text{ARG} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix} \right]$$

b.
$$\left[\text{CONT} \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RELS} & \left\langle \begin{bmatrix} scheibe\text{-}rel \\ \text{ARG0} & \boxed{1} \\ \text{ARG1} & \boxed{2} \end{bmatrix} \right\rangle \end{bmatrix} \right]$$

After clarifying the headedness question of a classifier phrase, it is possible to give a more detailed answer to the topic of Sec. 2.1. N1 and N2 seem to be combined by juxtaposing, but in fact, this combination should be realized through a *head-complement-phrase*, N1 is the head and N2 is the complement. An important point that distinguishes *cl-c-n* from *lex-c-n* is that classifiers look for a noun they need to fulfill their function of counting. And this noun (N2) needs to share the same CASE value as the classifier (N1), see (10). The distinction between the lexical entry of *Scheibe* 'slice.MCL', besides the semantics, is that the value of NUM for SCLs can only be *sg*.

(10)   Lexical entry for *Stück* 'SCL' (preliminary version without NUM and DET)

$$\left[\begin{array}{l} \text{CAT} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \text{CONC} \begin{bmatrix} \text{CASE} & \boxed{3} \end{bmatrix} \\ sort\text{-}cl\text{-}c\text{-}n \end{bmatrix} \\ \text{COMPS} \left\langle \text{NP} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \text{CONC} \begin{bmatrix} \text{CASE} & \boxed{3} \end{bmatrix} \\ m\text{-}n \end{bmatrix} \\ \text{IND} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{CONT} \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RELS} & \left\langle \begin{bmatrix} stück \\ \text{ARG} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix} \end{array} \right]$$

3 Adding numerals and determiners

So far it seems that when N1's COMPS is satisfied by N2, it is already a complete NP. But in fact, *Stück Vieh* cannot be directly selected by the verb unless it is preceded by a numeral or a determiner, i.e., (1) and (2). Therefore, numerals or determiners are required. But the syntactic behavior of *ein-* 'one' and other numerals is different, and next I will discuss them separately.

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[4]The adjectives modifying MCLs before MCL a different meaning, as in (7). In (7b) it is still about a counting-*Stück*, whereas *Stück* in (7a) is partitive, hence (7a) will not be discussed in this paper.

(7) a. ein groß-es   Stück Schokolade   b. ein süß-es   Stück Schokolade
     one big-NEU.ST.SG SCL   chocolate   one sweet-NEU.ST.SG SCL   chocolate

     'a large piece of chocolate'   'a sweet piece of chocolate'

[5]A similar method of index inheritance can be found in Levine (2010) about the analysis of parasitic heads.

3.1 Case 1: when Num is other than one

Referring to the analysis of other classifier languages, numerals are generally treated as a specifier or complement of the head classifier (Bender & Siegel 2004; Ng 1997). This means that the connection of a numeral to CL is specific and restricted. But when a definite article or demonstrative is present, German numerals other than one have a flexible position before the noun and can be exchanged in order with a Mod without affecting the truth condition of the phrase, see (11) and (12). Together with the fact that a numeral may not appear within a classifier phrase (2). It is reasonable to treat the numeral as a Mod, i.e., an undeclinable adjective.

(11) diese zwei trocken-en Scheibe-n Brot
     these two dry-WK.PL slice.MCL-PL bread
     'these two dry slices of bread'

(12) diese trocken-en zwei Scheibe-n Brot
     these dry-WK.PL two slice.MCL-PL bread
     'these two dry slices of bread'

But without a definite article or demonstrative this kind of Mod-flexibility of numerals disappears: numerals can only be placed on the leftmost side of the classifier phrase, comparing (13a) and (13b). In other words, in the absence of a definite determiner, the numeral seems to take over the function of a specifier in the classifier phrase. Just as with every count noun[6], the classifier phrase is not complete without this specifier, namely the numeral.

(13) a. zwei klein-e Scheibe-n Brot
       two small-ST.PL slice.MCL-PL bread

       'two small slices of bread'

b. * kleinen zwei Scheibe-n Brot
    small-ST.PL two slice.MCL-PL bread

    Int: 'two small slices of bread'

The analysis on numerals should fulfill both cases (12) and (13): a numeral is a modifier if there is a specifier within a classifier phrase, and the numeral will be the specifier if no other specifier is present. Therefore I assume that the HEAD value of a number is underspecified sort *num*, which has two subtypes, *num-det* (numeral-determiner) and *num-adj* (numeral-adjective) and that *num-det* is at the same time a subtype of *cl-det* (classifier-determiner) in (17).
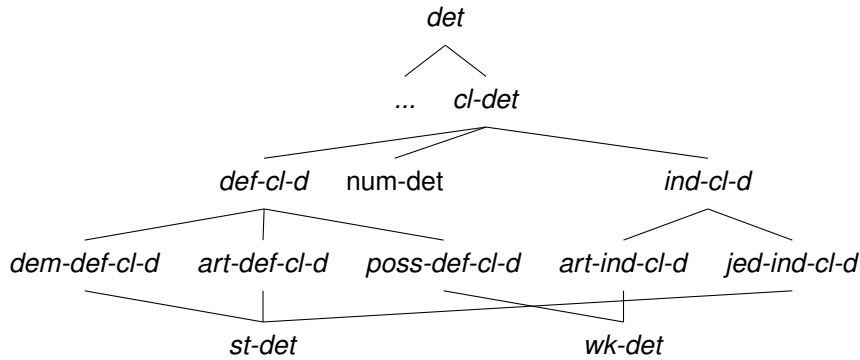
Now it is necessary to include the information of a specifier (15) in the entries of a classifier, i.e., a word with HEAD value *cl-n* must select a determiner of type *cl-det* to be its specifier. The CONC value of the specifier needs to be shared with its head, i.e. $\boxed{1}$. In German the specifier of a classifier can be: *dies-* 'this' (*dem-def-cl-d*), *d-* 'the' (*art-def-cl-d*), *mein-* 'my' (*poss-def-cl-d*), *zwei* 'two' (*num-det*), *ein-* 'one' (*art-ind-cl-d*), *jede-* 'every' (*jed-ind-cl-d*).

(14) Hierarchy of HEAD values for numerals

$$num$$

$$num\text{-}det \qquad num\text{-}adj$$

(15) SPR for a noun with [HEAD *cl-c-n*]

$$\left[\text{CAT}|\text{SPR} \left\langle \left[\text{DET} \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{CONC} & \boxed{1} \\ cl\text{-}det & \end{bmatrix} \\ \text{COMPS} & \langle\rangle \end{bmatrix} \right] \right\rangle \right]$$

(17) Hierarchy of HEAD values for determiners

(16) a. ein Thema dieses Jahr-es
      a theme this.DET.G.ST year-G
      'a theme of this year'

b. ein Thema dies-en Jahr-es
    a theme this.ADJ.G.ST year-G
    'a theme of this year'

c. ein Thema letzt-en Jahr-es
    a theme last.G.ST year-G
    'a topic of last year'

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[6]The difference is that in the case of a SCL, there is no bare plural, a specifier is always required. But *Scheiben* 'slice.MCL' allows a bare plural and there would be an optional specifier.

```
                              det
                              /\
                          ... cl-det
                          /         \
               def-cl-d  num-det      ind-cl-d
              /    |    \            /        \
    dem-def-cl-d art-def-cl-d poss-def-cl-d art-ind-cl-d jed-ind-cl-d
              \    |          \        /          |
               st-det          wk-det
```

The combination of *ind-cl-d* and *num-adj* in cases such as (18) is ruled out because a *num-adj* only modifies an NP with [NUM *pl*], and [NUM *sg*] only appears when the numeral is one, that is, a *num-det*. Two numerals, no matter whether *num-det+num-adj* or iteration of *num-adj*, are not possible for semantic reasons: there should be only one *card-rel* per *index*.

This underspecified treatment of *num* is further supported by empirical evidence. Both (16a) and (16b) are German expressions for *a theme of this year*, with *dies-* in (16a) being declined as a determiner, and (16b) being declined as an adjective analog to (16c).

(18) * ein / jedes zwei Stück Vieh
      one   every two   SCL   cattle

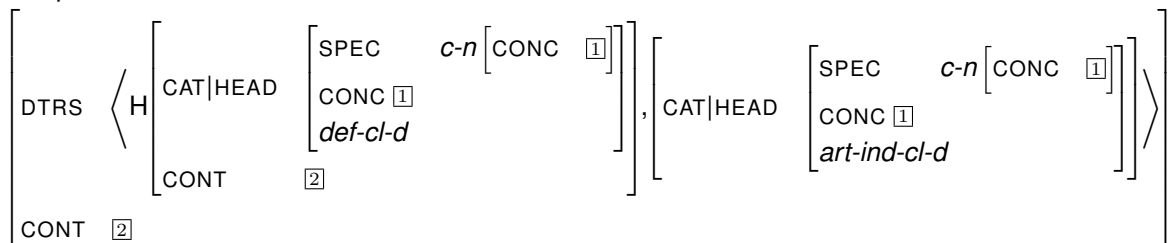   Int: 'a / every two head of cattle'

(19) das eine   Buch
      that one.WK.SG buch

      'the one book'

3.2 Case 2: iff Num=1

When the numeral is 1, i.e. *ein-* 'one' it has only the properties of a determiner. Even if there is already a definite determiner, the numeral one cannot change places with an adjective and must be fixed in the second position after the definite determiner, see (20). In this case, there exist two determiners tightly tied together and nothing can be inserted between them. Thus I assume a compound structure *compl-det* combining a *def-cl-d* and *art-ind-cl-d*. This complex determiner has *def-cl-d* as its head and can be selected by a *c-n* (not only by a *cl-c-n*), which correctly predicts (19) in German.

(20) a. diese ein-e   klein-e   Scheibe Brot
         that   one.WK.SG small-WK.SG slice.MCL bread

         'this one small slice of bread'

      b. * diese kleine   eine   Scheibe Brot
         that   small-WK.SG one.WK.SG slice.MCL bread

         'this one small slice of bread'

(21) *compl-det* $\Rightarrow$

$$
\begin{bmatrix}
\text{DTRS} & \left\langle H \begin{bmatrix} \text{CAT|HEAD} & \begin{bmatrix} \text{SPEC} & c\text{-}n \begin{bmatrix} \text{CONC} & \boxed{1} \end{bmatrix} \\ \text{CONC } \boxed{1} \\ \textit{def-cl-d} \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix}, \begin{bmatrix} \text{CAT|HEAD} & \begin{bmatrix} \text{SPEC} & c\text{-}n \begin{bmatrix} \text{CONC} & \boxed{1} \end{bmatrix} \\ \text{CONC } \boxed{1} \\ \textit{art-ind-cl-d} \end{bmatrix} \end{bmatrix} \right\rangle \\
\text{CONT} & \boxed{2}
\end{bmatrix}
$$

4 Conclusions

This paper provides an HPSG analysis for German numeral classifiers. Classifiers in German take N2 as a complement and need a specifier to be a full NP. This specifier can be realized by a determiner in the traditional sense but also by a numeral. Considering the flexible position of numerals other than *ein-* 'one', an underspecified HEAD value of numerals is proposed that makes the combination Det-Mod-Num possible. When the numeral is 1, a *comp-det* is introduced for ensuring that nothing can be inserted between these two determiners.

References

Bender, Emily M. & Melanie Siegel. 2004. Implementing the syntax of Japanese numeral classifiers. In *International Conference on Natural Language Processing*, Berlin: Springer.

Gunkel, Lutz, Adriano Murelli, Susan Schlotthauer, Bernd Wiese & Gisela Zifonun. 2017. *Grammatik des deutschen im europäischen Vergleich: das Nominal*, vol. 14. Berlin: Walter de Gruyter GmbH & Co KG.

Kobele, Gregory M & Malte Zimmermann. 2012. Quantification in German. In Edward L. Keenan & Denis Paperno (eds.), *Handbook of quantifiers in natural language*, 227–283. Dordrecht: Springer.

Krifka, Manfred. 1989. *Nominalreferenz und Zeitkonstitution. Zur Semantik von Massentermen, Pluraltermen und Aspektklassen*. München: Fink.

Krifka, Manfred. 1991. Massennomina. In Arnim von Stechow & Dieter Wunderlich (eds.), *Semantik. Ein internationales Handbuch der zeitgenössischen Forschung*, 399–417. Berlin/New York: De Gruyter.

Levine, Robert D. 2010. The ass camouflage construction: Masks as parasitic heads. *Language* 86(2). 265–301. `https://www.jstor.org/stable/40666321`.

Löbel, Elisabeth. 1986. *Apposition und Komposition in der Quantifizierung. Syntaktische, semantische und morphologische Aspekte quantifizierender Nomina im Deutschen*. Berlin/New York: De Gruyter.

Ng, Say Kiat. 1997. *A double-specifier account of Chinese NPs using Head-driven Phrase Structure Grammar*: University of Edinburgh MsC thesis.