# An implicational map of parts of speech

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## 1. Introduction[1]

The aim of this paper is twofold. First, we argue that the one-dimensional parts-of-speech hierarchy originally proposed in Hengeveld (1992) should be reanalyzed as the superficial manifestation of a two-dimensional implicational map. We show that this new map is more adequate than the earlier parts-of-speech hierarchy, since the former covers a number of counterexamples to the latter, without loss of accuracy.

Second, we explore the status of our proposal in relation to semantic map modelling in general terms. The map that we propose here shows that analytical primitives need not be exclusively semantic in nature, but may also include pragmatic dimensions, just as they might contain morphosyntactic or phonological ones. In addition, our model shows that implicational maps, which embody a series of implicational universals (Haspelmath 1997; 2003), can consist of several different types of implications that are hierarchically ordered with respect to one another.

The paper starts out with a brief description of the original parts-of-speech hierarchy in section 2. It then proceeds to present three types of counterexample to this version of the hierarchy in section 3. Section 4 presents the new two-dimensional map of parts-of-speech, the typological adequacy of which is discussed in section 5. Finally, in section 6 we conclude with a discussion of the nature of implicational maps in general terms.

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[1] We are indebted to Michael Cysouw and an anonymous reviewer for comments on an earlier version of this paper.

## 2. The former parts-of-speech hierarchy

Hengeveld, Rijkhoff and Siewierska (2004), itself based on Hengeveld (1992), classifies basic and derived lexemes in terms of their distribution across four propositional functions (a term introduced by Croft 2000, 2001), which are tabulated in Figure 1.

|  | *head* | *modifier* |
|---|---|---|
| *predicate phrase* | 1 | 4 |
| *referential phrase* | 2 | 3 |

Figure 1. Lexemes and propositional functions

Figure 1 shows that the functional positions 1-4 are based on two parameters, one involving the opposition between predication and reference, the other between heads and modifiers. Together, these two parameters define the following four propositional functions: head and modifier of a predicate phrase, and head and modifier of a referential phrase. The four propositional functions and their lexical expression can be illustrated by means of the English sentence in (1).

(1)     The tall$_A$ girl$_N$ sings$_V$ beautifully$_{MAdv}$

English can be said to display separate lexeme classes of verbs, nouns, adjectives and (derived) manner adverbs, on the basis of the distribution of these classes across the four propositional functions identified in Figure 1: Verbs like 'sing' are used as heads of predicate phrases; nouns like 'girl' as heads of referential phrases; adjectives like 'tall' as modifiers in referential phrases; and (derived) manner adverbs like 'beautifully' as modifiers in predicate phrases. Crucially, none of the content lexemes in (1) could be used directly in another propositional function, i.e. without morpho-syntactic adaptation. Thus, in this example there is a one-to-one relation between propositional function and lexeme class. Parts-of-speech systems of this type are called *differentiated*, and the lexical classes can all be said to be *specialized* for a certain propositional function.

There are other parts-of-speech systems in which there is no one-to-one relation between the four propositional functions identified and the lexeme classes available. These systems are of two types. In the first type, a single class of lexemes is used in more than one propositional function. Such lexeme classes, and the parts-of-speech systems in which they appear, are called *flexible*. The second type is called *rigid*. Rigid systems resemble differentiated systems to the extent that both consist only of lexemes classes that are specialized, i.e. dedicated to the expression of a single function. However, rigid systems are characterized by the fact that they do not have four lexeme classes; one for each of the four propositional functions. Rather, for one or more functions a lexeme class is lacking. The following examples illustrate the difference between these flexible and rigid parts-of-speech systems. In Turkish (Göksel & Kerslake 2005: 49) the same lexical item may be used indiscriminately as the head of a referential phrase (2), as a modifier within a referential phrase (3), and as a modifier within a predicate phrase (4):

(2)     *güzel-im*
        beauty-1POSS
        'my beauty'
(3)     *güzel    bir    kopek*
        beauty    ART    dog
        'a beautiful dog'
(4)     *Güzel    konuştu*
        beauty    s/he.spoke
        'S/he spoke well'

The situation in Krongo is rather different. This language has basic classes of nouns and verbs, but not of adjectives and manner adverbs.  In order to modify a head noun within a referential phrase, a relative clause has to be formed on the basis of a verbal lexeme, as illustrated in (5) and (6) (Reh 1985: 251):

(5)  *Álímì          bììtì.*
M.IPFV.be.cold     water.
'The water is cold.'


(6)  *bììtì    ŋ-álímì*
water  CONN-M.IPFV.be.cold
'cold water' (lit. 'water that is cold')


In (6) the inflected verb form *álímì* 'is cold' is used within a relative clause introduced by the bound connective *ŋ-*. This is the general relativizing strategy in Krongo, as illustrated by the following examples (Reh 1985: 256):


(7)  *N-úllà         à?àn    kí-ǹt-àndìŋ    [n-úufò-ŋ         kò-nììmò     kàtì].*
1/2-IPFV:love    I       LOC-SG-clothes   **CONN:N**-IPFV:sew-TR   poss-mother my
'I love the dress that my mother is sewing.'


(8)  *káaw    [m-àasàlàa-tí        àakʋ̀]*
person   **CONN:F**-PFV:look.at-1SG  she
'the woman that I looked at (her)'


This shows that *álímì* in (6) is not a lexically derived adjective but a verb that serves as the main predicate of a relative clause. Since this is the only attributive strategy available in Krongo, we can say that the propositional function of modification is expressed by relative clauses in this language, not by lexical modifiers.

The same strategy is used to modify a verbal head within a predicate phrase, as illustrated in (9) (Reh 1985: 345):


(9)  *ŋ-áa          árící ádìyà    kítáccì-mày  [n-íisò              túkkúrú.kúbʋ̀].*
CONN.M-COP    man INF.come   there-REF    **CONN**.M.IPFV-walk     with.low.head
'The man arrived walking with his head down.'


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The bound subordinating connector morpheme is added to the verb form *íísò* 'walk' in (9). This verb again fulfils the propositional function of head of a predicate phrase within the adverbial subordinate clauses, which as a whole fulfils the function of modifier in a (main) predicate phrase.
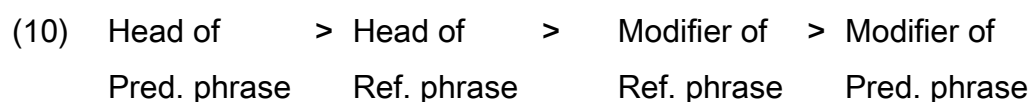
In sum, the difference between English (differentiated), Turkish (flexible), and Krongo (rigid), is thus that (i) Turkish has a class of flexible lexical items that may be used in several propositional functions, where English uses three specialized classes (nouns, adjectives, and manner adverbs), and that (ii) Krongo lacks classes of lexical items for the modifier functions, where English does have lexical classes of adjectives and manner adverbs. Krongo has to resort to alternative syntactic strategies to compensate for the absence of a lexical solution. These differences may be represented as in Figure 2.

| language | head of pred. phrase | head of ref. phrase | modifier of ref. phrase | modifier of pred. phrase |
|----------|---------------------|---------------------|-------------------------|--------------------------|
| Turkish | verb | non-verb | | |
| English | verb | noun | adjective | manner adverb |
| Krongo | verb | noun | - | - |

Figure 2: Flexible, differentiated, and rigid languages

As Figure 2 shows, Turkish and Krongo are similar in that they have two main classes of lexemes. They are radically different, however, in the extent to which one of these classes may be used in the construction of propositions: the Turkish class of non-verbs may be used in three propositional functions, while the Krongo class of nouns may be used as the head of a referential phrase only. Note that for a lexeme class to classify as flexible, the flexibility should not be a property of a subset of items, but a general feature of the entire class.

Hengeveld *et al.* (2004) argue that the arrangement of the propositional functions in Figure 2 is not a coincidence. It is claimed to reflect the parts-of-speech hierarchy in (10):

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(10)   Head of        > Head of        >     Modifier of   > Modifier of
       Pred. phrase      Ref. phrase           Ref. phrase       Pred. phrase


The more to the left a propositional function is on this hierarchy, the more likely it is that a language has a specialized class of lexemes to express that function and the more to the right, the less likely. The hierarchy is implicational, so that, for example, if a language has a specialized class of lexemes to fulfil the function of modifier of a referential phrase, i.e. adjectives, then it will also have specialized classes of lexemes for the functions of head of a referential phrase, i.e. nouns, and head of a predicate phrase, i.e. verbs. In addition, if a language has a flexible lexeme class that can be used to express the functions of head of a referential phrase and modifier in a predicate phrase, then it is predicted that this class can also be used for the expression of the functions lying in between these two on the hierarchy, namely modifier in a referential phrase. Similarly, if a language has no lexeme class for the function of modifier in a referential phrase (i.e. no adjectives), it will neither have a lexeme class for the function of modifier in a predicate phrase (i.e. manner adverbs). Note that the hierarchy makes no claims about adverbs other than those of manner.

      The hierarchy in (10), combined with the distinction between flexible, differentiated, and rigid languages, predicts a set of seven possible parts-of-speech systems, which is represented in Figure 3[2]. As this figure shows, it is predicted that languages can display three different degrees of flexibility (systems 1-3), three different

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[2] In addition to the seven types listed in Figure 3, Hengeveld *et al.* (2004) distinguish so-called intermediate systems, showing characteristics of two systems that are contiguous in Figure 3. Consider once more Turkish. We have shown above that this language has verbs and non-verbs as lexeme classes in its basic lexeme inventory, i.e. a type 2 feature. However, Turkish also displays a productive derivational process that produces flexible modifiers, which is a type 3 feature. Taking this derived class into account, Turkish must therefore be classified as a language of type 2/3. Mandarin Chinese has open classes of verbs and nouns, a type 6 feature, but also a restricted class of adjectives (see Paul 2005), a type 5 feature. Therefore, it is classified as a language of type 5/6. Including these intermediate types, the parts-of-speech Hierarchy predicts 13 possible types of parts-of-speech system.

degrees of rigidity (systems 5-7), or can be differentiated (type 4). Of the languages discussed earlier Turkish would be a type 2 language, English a type 4 language, and Krongo a type 6 language. Note that we use the term 'contentive' for lexical elements that may appear in any of the four functions distinguished. The term 'modifier' is used for lexemes that may be used as modifiers in both predicative and referential phrases.

| PoS system | head of pred. phrase | head of ref. phrase | modifier of ref. phrase | modifier of pred. phrase |
|---|---|---|---|---|
| 1 | contentive | | | |
| 2 | verb | non-verb | | |
| 3 | verb | noun | modifier | |
| 4 | verb | noun | adjective | manner adverb |
| 5 | verb | noun | adjective | |
| 6 | verb | noun | | |
| 7 | verb | | | |

Figure 3: Parts-of-speech systems

For further details on and argumentation for this approach to parts-of-speech systems see Hengeveld *et al.* (2004).

## 3. Counterexamples to the former parts-of-speech hierarchy

In recent research (Hengeveld & Van Lier 2008, Van Lier in preparation), we have attested a number of parts-of-speech systems with lexeme classes that are excluded by the parts-of-speech hierarchy in its original form. These lexeme classes are of three types, which we will discuss here.

The first unpredicted lexeme class is a flexible class that we call *nominals*[3]. The

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[3] This counterexample is also mentioned in the Universals Archive (http://typo.uni-konstanz.de/archive/intro/), where it is illustrated with examples from Kambera.

members of such a class can be used as the head and the modifier of a referential phrase. Nominals are attested for instance in Hungarian (Moravcsik 2000). This is illustrated in examples (11) and (12). In addition, these uses can be distinguished from appositional uses, which are also open to both object-denoting and property-denoting lexemes, as is illustrated in (13).

(11)   a.  *A     ház-ak-at       látom*
            the   house-PL-ACC   I.see
            'I see the houses.'
     b.  *A     nagy-ok-at   látom.*
            the   big-PL-ACC    I.see
            'I see the big ones.'

(12)   a.  *Ezr       a     bestia     nö-t         utálom.*
            this.ACC   the   beast     woman-ACC  I.hate
            'I hate this beast of a woman.'
     b.  *A     kél      ház-ak-at       látom.*
            the   blue    house-PL-ACC   I.see
            'I see the blue houses.'

(13)   a.  *A     ház-at,      a     szülöhely-em-et,    látom.*
            the   house-ACC   the   birth.place-SG.1-ACC  I.see
            'I see the house, my birthplace.'
     b.  *A     ház-at,      a     kék-et,    latom.*
            the   house-ACC   the   blue-ACC   I.see
            'I see the house, the blue one.'

The parts-of-speech hierarchy in (10) predicts that if a language uses the same class of lexemes in head and modifier function within referential phrases, it will use this class for modification in predicate phrases as well. However, this turns out not to be the case in

Hungarian, where the latter function is expressed by simple manner adverbs, as shown in (14), or by means of derived or case-marked nominals, as shown in (15a-b) (Kenesei et al. 1998: 221, 222):

(14)  *Ők    mindig    **külön**    utaz-nak.*
      They   always    separately  travel-INDF.3SG
      'They always travel separately.'

(15)  a.  *a    **hanyag-ul**    dolgoz-ó ember*
          the   careless-ESS    work-PTC  person
          'the person working carelessly'
      b.  *Attila    **csend-ben**    ki-men-t                     a    szibá-ból*
          Attila     silence-INESS   out-go-PST.INDF.3SG   the   room-ELAT
          'Attila left the room quietly.'

We thus have an unpredicted parts-of-speech class of nominals, occurring in a parts-of-speech system that is not compatible with Figure 3, and should be represented as in Figure 4.

| *language* | *head of pred. phrase* | *head of ref. phrase* | *modifier of ref. phrase* | *modifier of pred. phrase* |
|---|---|---|---|---|
| Hungarian | verb | nominal | | manner adverb |

Figure 4: Nominals in the PoS system of Hungarian.

The second type of counterexample is a lexeme class that we will call *predicatives*. It is again a flexible class, more specifically one the members of which can be used as both the head and the modifier of a predicate phrase. Predicatives are attested in Kayardild (Evans 1995: 306)[4], as illustrated in (16) and (17):

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[4] Evans (1995: 86, 303-304) describes the situation as follows: 'Verbals primarily denote actions and processes, but may also provide adverbial type information about the manner in which these are carried

(16)  *Ngada*      *mirrayala-tha*   *wangalk-l.*

       1SG.NOM    make-ACT        boomerang-LOC

       'I made a boomerang.'


(17)  *Ngada*      *mirrayala-tha*   *marri-ja kangk-i.*

       1SG.NOM    do.well-ACT      hear-ACT   language-LOC

       'I can understand the language well.'


Note that the lexeme that gets an adverbial interpretation cannot be analyzed as the predicate of what would be an adverbial clause, since it has to agree in its inflection with the main predicate. Thus Kayardild does not need to resort to a syntactic construction to create adverbial expressions, as in Krongo (9), but flexibly applies a single class of lexemes in two different propositional functions.

        Predicatives fulfil the functions at the two extreme ends of the parts-of-speech hierarchy. The hierarchy predicts that these lexemes should also be able to express the two intermediate functions (head and modifier of a referential phrase), but this in fact not the case, as can be seen in Figure 5 below. Note that the two intermediate functions in Kayardild can be expressed by a class of non-verbs, i.e. lexemes that can be used not only as the head and modifier within a referential phrase, but also as a modifier in a predicate phrase. This means that there are in fact two types of lexeme classes that can fulfil the function of modifier in the predicate phrase. The difference between these two classes is that non-verbs, unlike predicatives, take nominal inflection when they are used as manner adverbs (Evans 1995: 227-229).

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out (…).' He does mention that there are 'a few lexemes [which] only permit the modifier function'. However, Evans in fact lists only four such lexical adverbs, and about these remarks that 'it is possible that a bigger corpus would see even these used as main verbs'. We conclude from this that flexibility between the two functions is systematic in Kayardild.

| Language | head of pred. Phrase | head of ref. Phrase | modifier of ref. Phrase | modifier of pred. Phrase |
|---|---|---|---|---|
| Kayardild | predicative | (non-verbs) | | predicative |

Figure 5: Predicatives in the PoS system of Kayardild.

The third type of counterexample is attested (among other languages) in Garo (Burlings 1961: 27, 33). This language has a rigid parts-of-speech system, which is like the system in Krongo in that it lacks a class of adjectives and must instead use relative clauses to express the function of modifier in a referential phrase. This is illustrated in (18)-(19):

(18)   *Da'r-aŋ-gen.*
      big-it-FUT
      'It will get big.'

(19)   *da'r-**gipa**     mande*
      big-REL     man
      'the big man'

The example in (20) makes clear that *–gipa* is indeed a relativizer, rather than lexical derivational suffix (Burlings 2003: 301):

(20)   [*nok-o     pïsa-ko    nik-**gipa***]   metra
      house-LOC  child-ACC  see-REL    woman
      'the woman who saw the child at the house'

The parts-of-speech hierarchy predicts that a language without a separate class of adjectives will not have a class of manner adverbs either. However, Garo does have a large class of derived manner adverbs, formed through reduplication of verb stems, as

illustrated in (21) and (22). There are also a few basic ones, such as *tengre* 'fast, quickly' (Burlings 2004: 101, 267).

(21)   *jrip-jrang*
       'soundlessly, silently'

(22)   *ka'sine-ka'sine*
       'slowly'

Thus, it is not so much the distribution of the adverb class in Garo that is unpredicted, but rather its existence within the rest of the language's parts-of-speech system, which is represented in Figure 6:

| *language* | *head of pred. phrase* | *head of ref. phrase* | *modifier of ref. phrase* | *modifier of pred. phrase* |
|---|---|---|---|---|
| Garo | verb | noun | - | manner adverb |

Figure 6: Manner adverbs in the parts-of-speech system of Garo.

In order to account for these three types of counterexamples, a reconsideration of the parts-of-speech hierarchy is necessary[5].

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[5] Note that the three counterexamples discussed in this section do not make reference to the intermediate parts-of-speech systems discussed in footnote 2. However, our research (Hengeveld & Van Lier 2008; Van Lier in preparation) shows that the attested cross-linguistic variation in this type of parts-of-speech system is also more extensive than predicted by the original parts-of-speech hierarchy. Specifically, the 'extra' classes of intermediate parts-of-speech systems need not be contiguous, in terms of the hierarchy, to the rightmost large basic class of the particular system. They are also not always derived or small, closed classes. For example, a language may combine a class of contentives with a large, open class of rigid verbs, as is for instance the case in Santali (Neukom 2001). The parts-of-speech hierarchy would predict that contentives can only be combined with a derived class of non-verbs. In this paper, we will not go further into these cases. For more data and a full discussion we refer to Hengeveld & Van Lier 2008 and Van Lier in preparation, where we show that extra classes are added to parts-of-speech systems in accordance with the implicational restrictions to be outlined in the next section.

## 4. A new two-dimensional map of parts-of-speech systems

As we noted earlier, the parts-of-speech hierarchy is based on two parameters, one concerning the opposition between *predication* and *reference*, the other between *head* and *modifier*. With respect to the former parameter, we expect the function of predication to be privileged in relation to the function of reference, since referring expressions can only be created by predicating properties of an entity. Thus, in a noun phrase like *a yellow car* the properties 'car' and 'yellow' are predicated of the entity being referred to (see Bach 1968, Dik 1980: chapter 4). Regarding the second parameter, heads are obligatory and therefore primary in relation to optional modifiers. This is also shown by the fact that the lexical class of a modifier is dependent on the lexical class of its head. Thus, for each of the two parameters we predict the following hierarchical relations:

(23)    Predication ⊂ Reference
(24)    Head ⊂ Modifier

In addition, these two hierarchical relations can in turn be ranked with respect to one another. In view of the fact that there are (appositional) languages that do not use modification at all, while there are no languages that do not display the predication-reference distinction (even though they may not do so at the level of lexical classification, but rather at the level of syntactic constructions), we expect the predication-reference parameter to be primary in relation to the head-modifier parameter, as in (25):

(25)  ((Predication/Reference) ⊂ (Head/Modifier))

A further consequence of the combined effects of these parameters is that specialization of classes of lexical heads in the predicative domain is expected to precede specialization of classes of lexical heads in the referential domain.

We may now formulate three implicational constraints, which are given in general terms in (26)-(28):

(26) Predication ⊆ Reference

    a.    If a language has a specialized class of lexemes that can be used as the head of a referential phrase, it must also have a specialized class of lexemes that can be used as the head of a predicate phrase, i.e. if a languages has nouns, then it has verbs;

    b.    If a language has a flexible class of lexemes that can be used as the head of a referential phrase (but not as the head of a predicate phrase, since then the restriction becomes irrelevant), it must also have a flexible or specialized class of lexemes that can be used as the head of a predicate phrase, i.e. if a language has nominals or non-verbs, then it has verbs or predicatives.

(27) Head ⊆ Modifier

    a.    If a language has a specialized class of lexemes that can be used as the modifier within a phrase, it must also have a specialized class of lexemes that can be used as the head of that phrase, i.e. if a language has manner adverbs, then it has verbs, and if it has adjectives, then it has nouns;

    b.    If a language has a flexible class of lexemes that can be used as the modifier within a phrase (but not as the head of that phrase, since then the restriction becomes irrelevant), it must also have a flexible or specialized class of lexemes that can be used as the head of that phrase, i.e. if a language has modifiers, or non-verbs, then it has verbs (or a class of flexible heads, but this is excluded by principle (28)); and if a language has modifiers (or non-nouns[6], but this is excluded by principle (26a)), then it has nouns (or heads, but these are excluded by principle (28)).

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[6] By "non-nouns" we would mean a class of lexemes that can be used in all functions expect the head of a referential phrase.

(28)  ((Predication/Reference) ⊑ (Head/Modifier))[7]

   If a language has distinct (specialized or flexible) classes of lexemes for heads and
   modifiers within any phrase, then it has distinct (specialized or flexible) classes of
   lexemes for heads of predicate and referential phrases.

The parameters in (23)-(25) and the constraints in (26)-(28) are accounted for in the
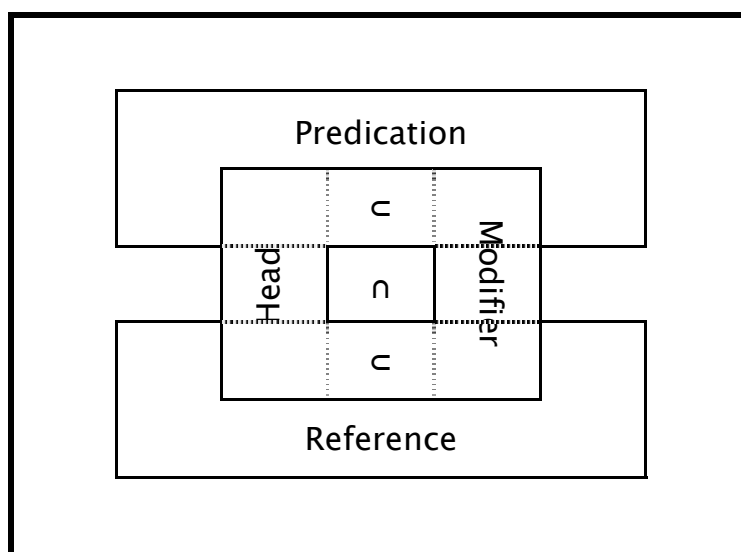layered implicational map in Figure 7.



Figure 7. The implicational map of parts-of-speech

Figure 7 shows that the Predication-Reference parameter ranks higher than the Head-
Modifier parameter (as indicated by the symbol ∩ in the centre), and that the Head-
Modifier parameter applies in the domains of both Predication and Reference, which
does not exclude that these domains share a single lexeme class, as in the case of
contentives, non-verbs, and modifiers.

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[7] What we explicitly do not want to suggest is that the Head-Modifier distinction must apply within the
predicative domain before it can apply in the referential domain. Thus the combination of (23/26) and
(24/27) should not be read as (PredHead ⊑ PredModifier) ⊑ (RefHead ⊑ RefModifier). Thanks to Michael
Cysouw for pointing this out to us.

## 5. Typological adequacy of the model: coverage and accuracy

In this section we assess the typological adequacy of the model proposed in the previous section, i.e. the degree to which it is capable of capturing all systems attested so far (coverage), and whether it excludes categories that are not attested (accuracy) (Cysouw 2007).

Starting with coverage, the map in Figure 7 handles all the systems that were consistent with the former parts-of-speech hierarchy, as shown in the simplified representations in Figures 8-14. The system in Figure 8 is consistent with our model because it involves no lexical distinctions at all. An example of a language that displays this type of PoS system is Kharia (Peterson 2006).
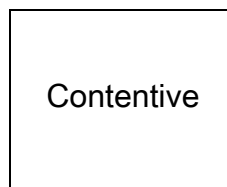
$$\boxed{\text{Contentive}}$$

Figure 8

The system in Figure 9 is consistent because it has both a flexible lexeme class that can be used as the head of a referential phrase and a rigid lexeme class for heads in the predicative domain (see (26b)); because it has both a flexible class of lexemes that can be used as a modifier within the predicate phrase and a rigid class of lexemes that can be used as the head of that phrase (see (27b)); and because it has distinct classes for heads and modifiers in the predicate phrase as well as distinct classes for heads of predicative versus referential phrases (see (28)). We have already discussed an example of this PoS system, namely Turkish.

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| Verb | |
|------|---|
| Non-verb | |

Figure 9

The system in Figure 10 is consistent because it involves a predication-reference distinction for heads but not for modifiers. This is in accordance with constraint (26a): A rigid class of nouns implies a rigid class of verbs. It is also in accordance with constraint (27b): the presence of flexible modifiers implies the presence of rigid heads. Finally, it conforms to constraint (28): Distinct classes for heads and modifiers imply distinct classes for the heads of predicative versus referential phrases. This PoS system is relevant for e.g. Dutch and German.

| Verb | Modifier |
|------|----------|
| Noun | |

Figure 10

The system in Figure 11 is consistent with the model because it involves head-modifier distinctions in both the predicative and the referential domain. This is in accordance with (26a), (27a) and (28). An example of this type of system is Georgian (Hewitt 1995).

| Verb | MAdv |
|------|------|
| Noun | Adj |

Figure 11

The system in Figure 12 differs from the one in Figure 11 only in that it lacks a lexeme class for the function of modification in predicate phrases, while the head function is this

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domain is expressed by verbs. This does not violate any of the constraints above[8]. A language that has this PoS system is Pipil (Campbell 1985).

| Verb | - |
|------|---|
| Noun | Adj |

Figure 12

The system in Figure 13 again has a predication-reference distinction in the head domain, but does not have lexical classes for either of the two modifier functions. This system conforms to (26a) since it has rigid classes of heads in both the reference and the predication domain, while constraints (27) and (28) are not applicable. We have shown above that this system is attested in Krongo.

| Verb | - |
|------|---|
| Noun | - |

Figure 13

The system in Figure 14, finally, has only one lexical class, namely one that fulfills the function of head of a predicate phrase. This does not violate any of the constraints. This system has not been attested in its pure form. However, there are certain languages that clearly place a larger burden on verbs than on nouns, in the sense of resorting to predicative constructions where many languages would use noun phrases. Tuscarora (Mithun 2000) and Hupa (Golla 1985) are examples of such languages.

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[8] Note that this would have been a violation of the nested implication (PredHead ⊂ PredModifier) ⊂ (RefHead ⊂ RefModifier), cf. note 7.

| Verb | - |
|---|---|
| - | - |

Figure 14

In addition to the previous systems, the implicational map in Figure 7 also covers the counterexamples to the former parts-of-speech hierarchy discussed in section 3. These systems are shown in Figures 15-17.

The system in Figure 15 is in accordance with (26b), since it has a flexible class for referential heads and a rigid class of predicative heads. It is also in accordance with (27a) in the predication domain, where it has rigid modifiers and rigid heads. Finally, it conforms to (28), since it has distinct classes for heads and modifiers in the predicate phrase, as well as distinct classes for heads in predicative versus referential phrases. This system, as we have seen, is attested for instance in Hungarian.

| Verb | MAdv |
|---|---|
| Nominal | |

Figure 15

The system in Figure 16 involves a lexical distinction between predication and reference, but not between heads and modifiers. This system is in accordance with (26b). Constraints (27) and (28) are not applicable. As we have shown above, so far this type of system has not been attested in its exact form; Kayardild does have predicatives, but in combination with non-verbs rather than nominals.

| Predicative |
|:-----------:|
| Nominal |

Figure 16

Finally, the system in Figure 17 has rigid lexeme classes for heads and modifiers in the predication domain, while in the reference domain it has a rigid lexeme class for heads. Thus, it is in accordance with (26a), (27a) and (28). This system has been illustrated above with Garo.

| Verb | MAdv |
|:----:|:----:|
| Noun | - |

Figure 17

It is to be noted that our model predicts seven further possible systems, namely those presented in Figures 18-24. The system in Figure 18 is in accordance with our constraint (26b), while (27) and (28) are not applicable. We have attested this system only in combination with a small, closed class of manner adverbs (cf. Figure 15), for instance in Nhanda (Blevins 2001).

| Verb | - |
|:----:|:----:|
| Nominal | |

Figure 18

The system in Figure (19) conforms to constraint (26b) since it has a flexible class of lexemes that can be used predicatively while not having a class of lexemes that can be used referentially. Constraints (27) and (28) do not apply. We have not attested this system in any language.

| Pred |   |
|:---:|:---:|
| - | - |

Figure 19

The system in Figure 20 involves a single flexible class of heads, which can be used in both predicative and referential phrases. It does not violate any of our constraints. This system has not been attested as such. However, it does seem to occur as an intermediate type, in combination with the system in Figure 13 above. Languages like Nivkh (Matissen & Drossard 1998) and West Greenlandic (Fortescue 1984, Sadock 2003) apparently have rigid classes of nouns and verbs, as well as a class of lexemes that can be used as both.

| Head | - |
|:---:|:---:|
|  | - |

Figure 20

The system in Figure 21 also involves a single flexible class, but one that can be used in all functions except modifier in a predicate phrase. This system does not violate any of the constraints[9]. Tagalog has this type of system. In this language, all content words can be used in all functions except that of modifier of a predicate phrase. To express the latter function, a predicative construction is used, as can be seen in example (29) below (Himmelmann 2007).

---

[9] Note that the lack of a lexeme class for the function of modifier in the predication domain does not mean that there is a head-modifier distinction in this domain.
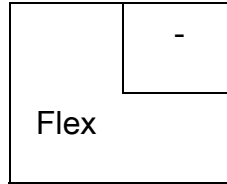
Figure 21

(29)   *biglaan   ang   kanyá-ng      alís*
       sudden   SPEC 3.SG.DAT-LK   departure
       'He left suddenly.' (lit. 'His departure was sudden.')

The system in Figure 22 is similar to the one in Figure 21, except that the flexible class can now be used in all functions except modifier in a referential phrase. So far, we have not attested this type of system.
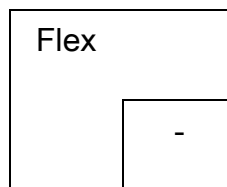

Figure 22

The system in Figure 23 has a flexible class of lexemes that can be used as the head of a referential phrase and a modifier in a predicate phrase, but not as a modifier in a referential phrase. This system has not been attested either.
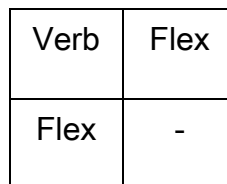

Figure 23

Finally, the system in Figure 24 involves two flexible lexeme classes: One class (Flex1) that can be used as the head of a predicate phrase and as a modifier in a referential phrase, and another class (Flex2) that can be used as the head of a referential phrase

and as a modifier in a predicate phrase. We have not attested this system in any language. In fact, this does not seem surprising, since both flexible classes in this system neutralize distinctions between opposite values of both the predication-reference and the head-modifier parameter. Intuitively, it would seem more probable to expect flexibility in cases where at least one parameters value is shared. However, on the basis of our restrictions, as formulated in (26), (26), (28), we are not able to exclude the system in Figure 24.

| | |
|---|---|
| Flex1 | Flex2 |
| Flex2 | Flex1 |

Figure 24

Summarizing, our model predicts 17 possible PoS systems, of which 7 were also predicted by the former parts of speech hierarchy. Of these 17 systems, we have attested 9 in their 'pure' form (the systems in Figures 8, 9, 10, 11, 12, 13, 15, 17, and 21) and 4 in some kind of intermediate form, i.e. in combination with other types of systems (the ones in Figures 14, 16, 18, and 20). Four systems (the ones in Figures 19, 22, 23, and 24) are predicted to be possible, but have not (yet) been attested by us.

Regarding accuracy, the model excludes 34 out of a total of 51 logically possible systems. Below, we list these systems one by one (Figures 25-58), and explicate which constraint(s) each of them violates. None of the excluded systems have been attested by us.

The system in Figure 25 is excluded since it has only one rigid class of heads, but in the reference rather than in the predication domain. As such it violates constraint (26a).

| | |
|---|---|
| - | - |
| Noun | - |

Figure 25

The system in Figure 26 has a rigid class of modifiers in the referential domain, without the corresponding rigid class of heads. As such it violates constraint (27a).

| | |
|---|---|
| - | - |
| - | Adj |

Figure 26

The system in Figure 27 also violates constraint (27a), since it has a rigid class of modifiers without the corresponding rigid class of heads, but this time in the predication rather than in the reference domain.

| | |
|---|---|
| - | MAdv |
| - | - |

Figure 27

The system in Figure 28 has distinct classes of heads and modifiers in the predication domain, while it does not have distinct classes for heads of predicative versus referential phrases. Thus, constraint (28) is violated.

| Verb | MAdv |
|------|------|
| -    | -    |

Figure 28

The system in Figure 29 violates constraint (27a), since is has a rigid class of modifiers in the reference domain, without the corresponding rigid class of heads.

| Verb | -   |
|------|-----|
| -    | Adj |

Figure 29

The system in Figure 30 violates two constrains: There is a single rigid class of heads, but not in the predication domain. Thus, constraint (26a) is violated. In addition, there is a head-modifier distinction in the referential domain, but there are no distinct classes of lexemes for heads of predicative versus referential phrases, so that constraint (28) is violated as well.

| -    | -   |
|------|-----|
| Noun | Adj |

Figure 30

The system in Figure 31 also violates two constraints: It has a single rigid class of heads, but not in the predication domain, so that (26a) is violated. Furthermore, (27a) is violated in the predication domain, where there is a rigid modifier class without the corresponding rigid head class.

| | |
|---|---|
| - | MAdv |
| Noun | - |

Figure 31

The system in Figure 32 has two rigid classes of modifiers, without the corresponding rigid classes of heads, so that (27a) is violated in both the predication and the reference domain.

| | |
|---|---|
| - | MAdv |
| - | Adj |

Figure 32

The system in Figure 33 violates three constraints: (26a), since there are rigid heads in the referential but not the predicative domain, (27a) since in the predication domain there is a rigid modifier class but no rigid head class; and (28) because there is a head-modifier distinction in the referential domain, but no distinct classes for heads of predicative versus referential phrases.

| | |
|---|---|
| - | MAdv |
| Noun | Adj |

Figure 33

The system in Figure 34 violates constraint (27a), since it has a specialized class of lexemes that can be used as the modifier in a referential phrase, but no lexeme class to express the head of a referential phrase. In addition, this system violates constraint (28), since it has distinct classes for heads and modifiers in predicate phrases, but no distinct classes for heads of referential phrases, as opposed to predicate phrases.

| Verb | MAdv |
|------|------|
| -    | Adj  |

Figure 34

The system in Figure 35 violates constraint (28): There is lexical distinction between head and modifiers, but no distinct classes for heads of predicative versus referential phrases.

| Head | Mod |
|------|-----|

Figure 35

The system in Figure 36 is excluded since it has two rigid classes of modifiers, without the corresponding rigid classes of heads. As such it violates constraint (27a) in both the predication and the reference domain.

| Head | MAdv |
|------|------|
|      | Adj  |

Figure 36

The system in Figure 37 is excluded because it violates constraint (27a): It has a specialized class of lexemes that can be used as the modifier in a predicate phrase, but not a specialized class for heads of predicate phrases.

| | MAdv |
|------|------|
| Head | - |

Figure 37

The system in Figure 38 also violates constraint (27a), but in the referential domain, where it has a specialized class of modifiers, but not a specialized class of heads.

| | - |
|------|------|
| Head | Adj |

Figure 38

The system in Figure 39 is excluded because it has a class of lexemes that can be used as the head of a referential phrase, but no class of lexemes that can be used as the head of a predicate phrase (verbs or predicatives). Thus, it violates constraint (26b).

| - | - |
|---|---|
| Nominal | |

Figure 39

The system in Figure 40 violates two constraints: It has a flexible class of lexemes that can be used as the head of a referential phrase, but no class of lexemes that can be used as the head of a predicate phrase. Thus, it violates (26b). In addition, it has a rigid class of modifiers in the predication domain, but not the corresponding heads, so that it also violates (27a).

| | MAdv |
|---|---|
| - | |
| Nominal | |

Figure 40

The system in Figure 41 violates constraint (27b): It has a flexible class of modifiers, but no heads, i.e. nouns and verbs.

| | Mod |
|---|---|
| - | |
| - | |

Figure 41

The system in Figure 42 is excluded because it violates constraint (28): There is lexical distinction between head and modifiers in the predication domain, but there are no distinct classes for heads of predicative versus referential phrases.

| | Mod |
|---|---|
| V | |
| - | |

Figure 42

The system in Figure 43 also violates constraint (28). In addition, it violates constraints (26a): it has a rigid class of heads for referential but not for predicate phrases.

| | Mod |
|---|---|
| - | |
| N | |

Figure 43

The system in Figure 44 has a flexible class of lexemes that can be used as the head of a referential phrase, but no a class of lexemes that can be used as the head of a predicate phrase (verbs). Thus, it violates constraint (26b). Furthermore, it has a flexible class of lexemes that can be used as a modifier in the predicated phrase, without class of rigid heads for this phrase. Thus, it also violates constraint (27b).
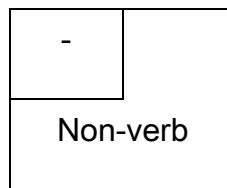


Figure 44

The system in Figure 45 is excluded on the basis of constraint (27b): It has a flexible class of lexemes that can be used as the modifier (but not the head) in a referential phrase, but not the corresponding class of heads.
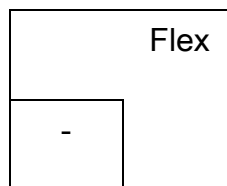


Figure 45

The system in Figure 46 is excluded because it has a rigid head class in the referential, but not in the predication domain. As such, it violates constraint (26a).
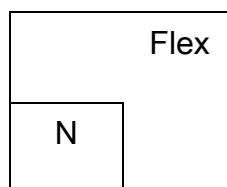


Figure 46

The system in Figure 47 involves a rigid modifier class in the referential domain without the corresponding rigid head class and thus violates (27a). In addition, it involves

30

distinct classes for heads and modifier in the referential domain, without distinct classes of heads of predicative versus referential phrases. Thus, it also violates (28).

```
┌──────────────────┐
│ Flex             │
│         ┌────────┤
│         │ Adj    │
│         │        │
└─────────┴────────┘
```
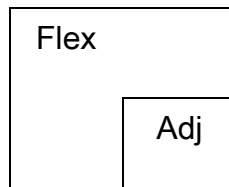
Figure 47

The system in Figure 48 is excluded for the same reasons as the system in Figure 40, except that constraint (27a) is now violated in the predication domain.

```
┌─────────┬────────┐
│         │ Madv   │
│         │        │
├─────────┘        │
│ Flex             │
│                  │
└──────────────────┘
```

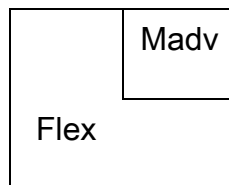Figure 48

The system in Figure 49 violates constraint (26a): It has a rigid class of heads in the referential but not the predication domain.

```
┌──────────────────┐
│ Predicative      │
│                  │
├─────────┬────────┤
│ Noun    │ Adj    │
│         │        │
└─────────┴────────┘
```
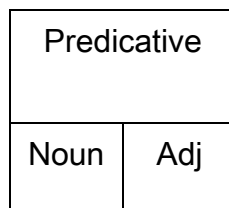
Figure 49

For the same reason, the system in Figure 50 is excluded:

| Predicative | |
|---|---|
| Noun | - |

Figure 50

The system in Figure 51 violates constraint (27a): It has a class of rigid modifiers in the reference domain, but not the corresponding rigid class of heads.

| Predicative | |
|---|---|
| - | Adj |

Figure 51

The system in Figure 52 involves a flexible class of lexemes that can be used as the heads of a referential phrase and as a modifier in a predicate phrase. It is excluded because it violates constraint (27a) in the reference domain, where it has a rigid modifier class without a rigid head class.

| Verb | Flex |
|---|---|
| Flex | Adj |

Figure 52

The system in Figure 53 is excluded because it violates four constraints. It violates constraint (26b) because it has a flexible lexeme class that can be used as the head of a referential phrase, but no lexeme class for heads of predicate phrases. In addition, this system violates constraint (27a) in the reference domain, since it has a specialized class of lexemes for modification in the referential phrase, but no specialized class for heads of referential phrases. It also violates constraint (27b), because it has a flexible

32

class of lexemes that can be used as the modifier (but not the head) of a predicate, without a lexical class for heads in predicate phrases. Finally, this system violates constraint (28): it has distinct classes for heads and modifiers in referential phrases, but no distinct class for heads of predicate phrases.

| - | Flex |
|------|------|
| Flex | Adj |

Figure 53

The system in Figure 54 is excluded because it violates constraint (26b): it has a flexible lexeme class that can be used as the head of a referential phrase, but no lexeme class for heads of predicate phrases. In addition, this system violates constraint (27b) in the predication domain, where it has a flexible class of lexemes that can be used for modification, but no class for heads.

| - | Flex |
|------|------|
| Flex | - |

Figure 54

The system in Figure 55 involves a flexible lexeme class that can be used as the head of a predicate phrase and as a modifier in a referential phrase. It is excluded because it violates constraint (26a): It has a rigid class of heads in the referential, but not in the predication domain. In addition, it violates constraint (27a) in the predication domain, where it has a rigid modifier class but no rigid head class.

| Flex | Adv |
|------|-----|
| N | Flex |

Figure 55

It should be stressed that the system in Figure 55 does not represent the situation found in languages with predicative adjectives (or 'verby' adjectives (Stassen 1997)). Although in such languages it may be the case that all adjectives can be used as verbs, the reverse is not true: When verbs are used as referential modifiers, they take the form of relative clauses. This occurs for instance in Berbice Dutch Creole (Kouwenberg 1994). This means that there is no bi-directional flexibility (cf. Evans & Osada 2005).

The system is Figure 56 is excluded because it violates constraint (26a): It has a rigid class of rigid class of heads in the referential, but not in the predication domain.

| Flex | - |
|------|-----|
| N | Flex |

Figure 56

The system in Figure 57 is excluded because it violates constraint (27a) in the predication domain, where it has a specialized class for modifiers, but a flexible class for heads. In addition, this system violates constraint (27b) in the reference domain, where it has a flexible class for modifiers, but no class for heads. Finally, this system violates constraint (28): it has distinct classes for heads and modifiers in the predicate phrase, but no distinct classes for heads of referential phrases, as opposed to predicate phrases.

| Flex | Adv |
|------|-----|
| - | Flex |

Figure 57

The system in Figure 58 violates constraint (27b), since it has a flexible lexeme class that can be used as a modifier in a referential phrase, but no lexeme class that can be used as the head of a referential phrase.

| Flex | - |
|------|------|
| - | Flex |

Figure 58

In sum, this section shows that the new implicational map of parts-of-speech has increased typological adequacy compared to the original parts-of-speech hierarchy. In particular, this new approach predicts 17 possible systems, out of 51 logical possibilities. Out of the 17 predicted systems, 9 are attested in their pure form and 4 in intermediate type systems. Another 4 predicted systems have not (yet) been attested. The model excludes 34 systems out of the 51 logically possible ones. We have attested none of the excluded systems in actual languages.

## 6. Conclusion: from semantic to implicational maps

The model proposed in this paper can be related in several ways to the general methodology of semantic maps. First, our model shows that analytical primitives of 'semantic' maps need not be exclusively semantic in nature, but may also include other domains of grammar, which is why we use the term 'implicational' map in the title of this paper. In the parts-of-speech map, the predication-reference parameter and the head-modifier parameter each pertain to different functional dimensions, neither of which is connected to the denotational semantics expressed by the linguistic units involved, but rather to ways in which lexical items are used to create predicating and referring expressions.

Second, the proposed new analysis of parts-of-speech systems uses what has become known as the 'semantic map' methodology to analyse an important morpho-

syntactic property of languages. As Haspelmath (1997, 2001) points out, implicational maps embody a series of implicational universals. In this paper, we have tried to take this approach one step further by introducing hierarchical ranking of different types of implicational relations. In other words, we have attempted to create an implicational map that is an instantiation of a hierarchy of hierarchies. It is evident that the potential recursivity of this procedure takes us from two-dimensional implicational maps to multidimensional implicational networks, which require other forms of visualization and a more sophisticated analytical methodology.

In taking this approach, a serious problem of the semantic map methodology is avoided. As Haspelmath (2003) and Cysouw (2007) note, traditional semantic maps are not specified for frequency of attestation of a specific language structure, since they plot contiguity constraints and diachronic pathways that are not by themselves implicational in nature. This does not hold for the map proposed in the present paper: by combining implicational hierarchies in a single model and ranking them with respect to each other, it predicts which parts of speech are less marked along two dimensions, and therefore more frequently attested (e.g. verbs) and which parts of speech are more marked along two dimensions and therefore less frequently attested (e.g. adjectives).

## Abbreviations used (those that do not appear in the Leipzig Glossing Rules)

ACT    =    active voice

CONN   =    connector

ELAT   =    elative case

ESS    =    essive case

LK     =    linker

SPEC   =    specifier

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