

Catenae in Morphology

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Abstract

This paper argues for a renewed attempt at morphology in dependency grammar. The proposal made here is based on the concept of the “catena” proposed by Authors (in press). The predecessor to this notion was the “chain” introduced by O’Grady (1998), and employed by Osborne (2005) and Groß and Osborne (2009). In morphology and morphosyntax, a *morph catena* is A MORPH OR A COMBINATION OF MORPHS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. This concept allows for a parsimonious treatment of morphology on the surface. The fact that no additional terms and concepts are necessary for the analysis of morphological data is highly desirable because it makes a fluid transition from syntax to morphology possible. This paper introduces the relevant dependency relationships seen operating in morphology, and shows how they can be used to explain compound structure, bracketing paradoxes, and multiple periphrasis.

1 Introduction

Hays (1964: 517f; see in particular the second example on page 518) may have been the first to recognize the merit of extending the notion of dependency into morphology. The motivation for doing so is clear: the complexity of word structure in languages differs, and if dependency grammar desires to say something enlightening about languages with different word structure, then it must have the means to do so. Heringer (1970: 96f) provided perhaps the first dependency trees that included separate nodes for morphs. Anderson (1980) was the first to use the label “dependency morphology”, in his analysis of Basque verbs. Both Heringer’s and Anderson’s analyses are characterized by the assumption that derivational and inflectional morphs depend on the lexical morphs with which they form words. This assumption has carried on to the present (e.g. Eroms 2010: 38f). Speculating on the reasons for this assumption, the European tradition sees dependency grammar as the theoretical background for valency theory. A brief look at Ágel and Fischer (2010) confirms this evaluation; valency theory is treated prominently and initially on 14 pages, while dependency grammar

takes the backseat with just 8 pages. Valency theory is characterized by putting valency-bearing lexical items at center stage. Assuming that non-lexical material is somehow subsumed by lexical material seems on a logical trajectory. But research in typology, foremost Bybee (1985), has confirmed that affixes as expressions of valency, voice, aspect, modality, tense, mood, and person obtain in a specific linear order (or hierarchy), and developments in generative grammar during the 1980’s emphasized the dominance structure of the IP/TP, where such affixes are thought to be located. Similar statements also concern NP structure: if case or plural is expressed by morphs, then these morphs appear in peripheral position, an indication that they dominate their nouns. In general, it is safe to say that dependency grammar has missed out on important trends and insights, and this has severely hampered any formulation of a dependency-based morphology. The fact that Anderson went on to establish “dependency phonology” (Anderson & Ewen 1987) instead of pursuing his initial program of dependency morphology, is a case in point. Among the widely known dependency grammars, only Mel’čuk’s Meaning-Text-Theory (1988) and Hudson’s Word Grammar (1984, 1990, 2007) explicitly address morphology. While the notion of dependency can be considered as established in syntax and phonology, morphology is still underdeveloped. In recent times, Harnisch (2003) and Maxwell (2003) have argued again that dependency grammar must achieve a better understanding of the morphological component.

This paper outlines a proposal for a dependency morphology based on the notion of “chain”, which was introduced by O’Grady (1998). O’Grady shows that many idioms do not qualify as constituents, rather they form incomplete dependency trees, which he called “chains”. Osborne (2005) recognized the versatility of this notion for dependency grammar. Groß and Osborne (2009) use the chain concept to address discontinuous structure in syntax, and Groß (2010) endeavors, in a first attempt, to apply the chain to word structure, arguing that bracketing paradoxes and multiple auxiliary constructions

can be quite easily resolved. Below, however, the term *catena* will be used instead of “chain” because “chain” is understood in an entirely different way in derivational theories of syntax. This decision is also motivated by the work of Osborne et al (in press), who show that the catena, rather than the constituent, is implicated in idiom formation, ellipsis, and predicate formation. They define a catena (in syntax) as A WORD OR A COMBINATION OF WORDS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. This definition identifies any dependency tree or subtree of a tree as a catena. By replacing “word” with “morph”, the catena is also available for morphology.

This paper proceeds as follows: Section 2 informs on the central notions and shows how they are used to explain morphological dependencies within and across words and with clitics. It also illustrates briefly that non-concatenative morphology can be dealt with. Section 3 concerns compounds: gradient compound structure as well as exocentric compounds are explained. Section 4 addresses bracketing paradoxes. Section 5 demonstrates that a catena-based approach can parsimoniously account for multiple periphrasis. A final section concludes the paper.

2 Catena-based morphology

Building on Osborne et.al. (in press), a *morph catena* is a MORPH OR A COMBINATION OF MORPHS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. The choice of “morph” instead of “morpheme” is motivated by the need to maintain a surface-oriented level of analysis. A *morph* is loosely defined as any meaning bearing unit that cannot be reduced any further, but that can be separated from other meaning bearing units in the horizontal AND/OR vertical dimension.¹ The inclusion of the notion “vertical dimension” allows for the treatment of phenomena subsumed under non-concatenative morphology (trans- and suprafixation, reduplication, etc.), as briefly demonstrated below. This section addresses morph dependencies within and across words, clitics, and non-concatenative morphology.

2.1 Within words

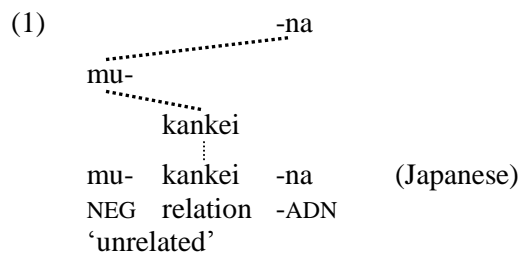
Morph catenae obtain in morphology proper, i.e. inside words, and in morphosyntax, i.e. across

¹ While there are certainly difficulties with the notions “morph” and “morpheme” (cf. Mel’čuk 2006: 384ff), the proposal here is sufficient in the present context.

words. A dependency relationship between morphs inside the same word is called an *intra-word* dependency. Intra-word dependencies are determined by distribution:

If the combination of two morphs M_1 and M_2 distributes more like M_2 than like M_1 , then M_1 is a dependent of M_2 .

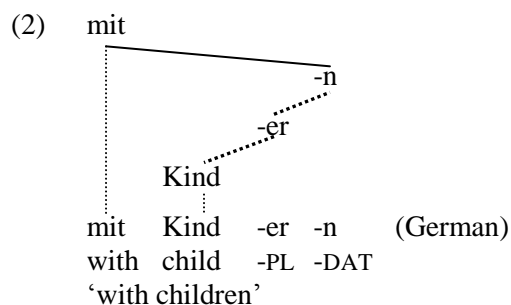
This definition is similar to Mel’čuk’s definition of “surface syntactic dominance” (2003: 200f). The next example from Japanese illustrates intra-word dependencies:



The intra-word dependencies are represented by the dotted edges (as opposed to solid edges). The lexical morph *kankei* receives a (vertical) projection edge. The hyphens represent phonological attachment (in the horizontal dimension). The negation prefix *mu-* phonologically attaches to the next morph to its right, and the attributive suffix phonologically *-na* attaches to the next morph to its left; in (1) this morph is *kankei*. The prefix *mu-* must depend on the suffix *-na* because the morph combination *mu-kankei* distributes like a member of the lexical class of nominal adjectives “*keiyō meishi*”. The morph catena *kankei-na* is not possible because *kankei* is a noun rather than a nominal adjective. Intra-word dependencies are thus motivated on the basis of distribution.

2.2 Across words

An inter-word dependency is a morphosyntactic relationship between a morph and a word. If the morph licenses the appearance of the word, then the morph *governs* the word. The next example illustrates that with an example from German:

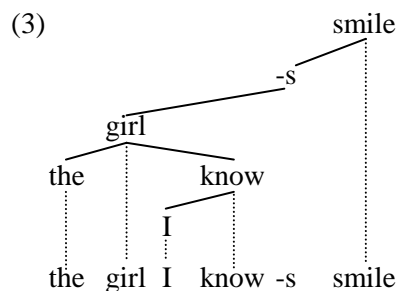


Example (2) shows the two units *mit* and *Kind-er-n*. The former qualifies as a word and a morph, while the latter only qualifies as a word. Again, the dotted edges represent the intra-word dependencies inside the noun: the plural suffix *-er* is seen as dominating the noun *Kind* because *Kind-er* distributes like a plural noun, rather than like the singular noun *Kind*. The dative case suffix is seen as dominating the plural noun because the dative case should encompass the entire plural noun *Kind-er* rather than just singular *Kind*. The noun *Kind-er-n* is dominated by the preposition *mit*. Since *mit* can be seen as a morph, *Kind-er-n* is a dependent of *mit*, *mit* licensing the appearance of the entire word *Kind-er-n*.

Note that the morphs in examples (1) and (2) qualify as morph catenae. In (1) the following morph catenae obtain: *mu-kankei*, *mu-...-na*, the individual morphs, and the entire expression. In (2) *Kind-er*, *-er-n*, *Kind-er-n*, *mit...-n*, *mit...-er-n*, the individual morphs and the entire expression qualify as morph catenae.

2.3 Clitics

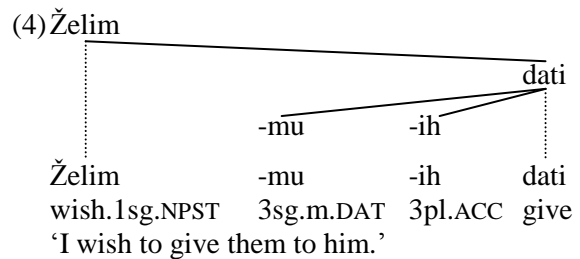
Clitics are morphs on the borderline between free and bound morphs (Klavans 1985, Kaisse 1985, Nevis 1986, Zwicky 1987, Anderson 1992, 2005 and others). Clitics express meanings usually reserved for free morphs, but fail – for whatever reasons – to appear as individual prosodic words. In the current system, these properties are expressed by the following tree conventions: A clitic appears without a projection edge but with a hyphen and a solid dependency edge.



The possessive *-s* depends on the following *smile*, seemingly like a full word.² It also governs the noun *girl* like a full noun. However, the clitic appears without a projection edge in exactly the fashion bound morphs would. Like bound morphs, the clitic must be prosodically dependent

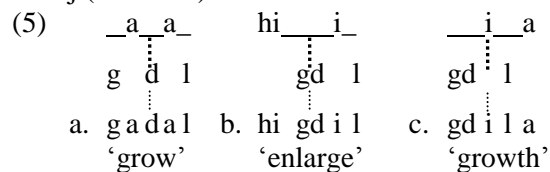
² A reviewer suggests the possibility of a DP analysis such that the clitic dominates both *girl* and *smile* which would result in a D-projection of the entire expression. Evidence for DP is, however, ambiguous at best, and as a result the current account rejects DP.

on a morph capable of constituting a prosodic word, or it must depend on a morph that depends on such a morph, and so on, recursively. “Wackernagel” or “second position” clitics challenge many theories. In the approach here, these clitics can appear as quasi-words but must be prosodically dependent on – most often – the final morph of the first minimal prosodic unit. This is illustrated with a Serbo-Croat example taken from Corbett (1987: 406). There the clitics *-mu* and *-ih* depend on *dati*, but they are part of the prosodic word formed by *Želim*. *-ih* prosodically depends on *-mu*, which depends on *Želim*.



2.4 Non-concatenative morphology

The morph catena can also accommodate phenomena from non-concatenative morphology. The ability to accommodate transfixation is demonstrated next with Hebrew data, taken from Booij (2007: 37):

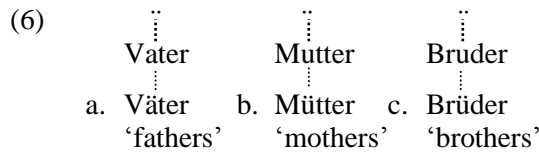


The lower consonant series in (5a-c) constitute the lexical morph *gd l*, which expresses the vague meaning of ‘grow’. The transfixes *_a_a_* ‘infinitive’, *hi_i_* ‘causative’, and *_i_a_* ‘nominalizer’ are seen as dominating the lexical morphs because their appearance affects the distribution of the entire expression. The “root” morph and the transfixes qualify as morphs because they can be separated from one another in the vertical dimension. The resulting horizontal units are the respective morphs. The slots in the transfixes fulfill the role of the hyphen in concatenative morphology.³

Ablaut can be analyzed in a similar fashion. In some German nouns, the plural is formed solely by ablaut: *Vater* – *Väter*, *Mutter* – *Mütter*, *Brud-*

³ A reviewer comments on whether tmesis such as *abso-bloody-lutely* can be accommodated. In view of the analysis in (5), one can assume that such an analysis is possible in the current system, even though I refrain from providing one due to space reasons.

er – *Brüder* etc. Since the appearance of the ablaut changes the distribution of the whole expression, it is seen as the root:



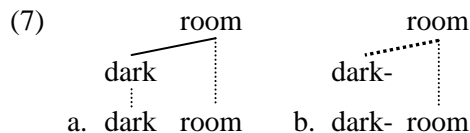
The ablaut, represented by “”, now constitutes an individual node that can be accessed. The dotted dependency edge is now completely vertical, a feature also present in infixation, transfixation, and suprafixation. Reduplication, suprafixation, and infixation can be accommodated in a similar vein.

3 Compounds

Compounds are words containing at least two lexical morphs. Because lexical morphs have the ability to constitute prosodic words, the appearance of two lexical morphs in one prosodic word requires one of these morphs to be integrated into the prosodic word structure of the other.

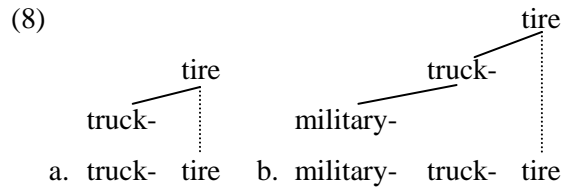
3.1 Compound gradience

Compounds are of particular interest for dependency morphology because the semanto-syntactic connection between compound parts exhibits gradience. Consider the next English examples:



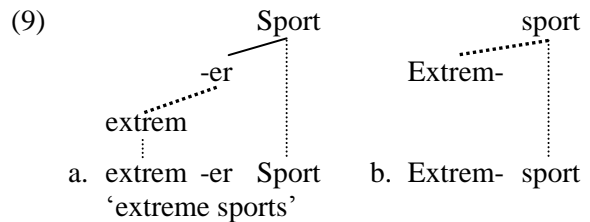
Example (7a) shows a purely syntactic dependency relationship. The attributive adjective can still be modified by e.g. *very*. In (7b), that is impossible, hence this expression is a compound. Because *dark-room* denotes a kind of room, not a kind of dark(ness), *room* is seen as the root dominating the adjective. The adjective is integrated into the prosodic word structure of the morph *room*, which is represented by the hyphen on *dark-*. Morphs must either be marked by a hyphen or receive a projection edge (but never both).

The words in (7a-b) represent the endpoints of a compound continuum. English allows compounds to reside between these two end points, as the next examples demonstrate:



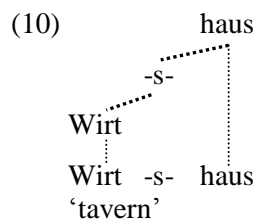
Example (8a) is a compound, but unlike (7b). Here *truck-*, can still be modified, as (8b) illustrates. The truck is a military type of truck, rather than the tire being a military type of tire. This kind of compound is less syntactic than (7a), but more syntactic than (7b); this fact is represented by the solid dependency edge between the compound parts.

German seems to dislike (8a)-type compounds. Modifying adjectives must appear without their attributive suffixes, an indication that the modified noun has lost the ability to license the appearance of attributives:



In (9a) the adjective is a regular attributive adjective, and it can be modified by *sehr* ‘very’. In (9b) however, the adjective is integrated into the prosodic word structure of *sport*, and it cannot be marked with the attributive suffix *-er* (or any other inflectional suffix), thus indicating compounding.

But German can build compounds by using the Fugen *-s-*:

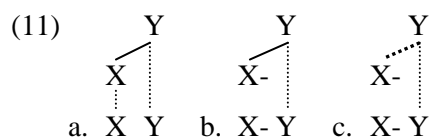


Example (10) is very simple, and much more complex examples exist (e.g. *Einzugsermächtigung* ‘collection authorization’). The important issue here is that *-s-* combines two units, each of which requires one of its morphs to be marked with a projection edge (here: *Wirt* and *haus*). The hyphens on either side of *-s-* signal this important function; technically, *-s-* functions as an infix.

3.2 “Exocentric” compounds

Exocentric compounds come in different types:⁴ in *bahuvrihi* compounds, the meaning of the entire expression cannot be deduced from its parts, or only with great difficulty, e.g. *skinhead*, *old-money*, *bluecollar*, etc. Other types of exocentric compounds defy morphological categorization. The words *musthave* and *kickback* are nouns (rather than verbs), auxiliaries, or prepositions. Furthermore, there are *dvandva* compounds: copulative *dvandva* have two (or more) semantic heads such as *bitter-sweet* or *sleep-walk*, and in appositional *dvandva* the compound parts contribute to a similar degree to the meaning of the entire expression, such as in *maid-servant*.

At first blush, *bahuvrihi* and *dvandva* compounds are removed from productive compounds to a significant degree. *Bahuvrihi* such as *skinhead*, which means a certain type of person, rather than a body part, are in the process of idiom formation or have already completed this process. Applying O’Grady’s (1998) lesson of syntactic idioms to compounding leads to the straightforward assumption that the units involved in these types of compound must qualify as catenae if they are to be retained in the lexicon. But the lexicon, as understood in construction grammar, also contains constructions, which is why Goldberg (1995) calls it “constructicon” rather than lexicon. Concerning compound constructions, English requires the root of the compound to be a nominal, i.e. a noun, adjective, or some other nominal form. In other words, the English compound construction continuum could look like this (with the horizontal order being free):



Construction (11a) is purely syntactic, like (7a). In the next step (11b), X loses its ability to constitute a prosodic word, but still retains the ability to govern modifiers. At stage (11c), the ability to govern modifiers is relinquished. Beyond that stage, a new morph obtains. The example *truck-tire* in (8a) is at stage (11b), while (11c) is accurate for *dark-room* in (7b). In general, a construc-

⁴ The literature on this topic is quite extensive. Compounding and their types are treated in Fabb (1998), Olsen (2000), Ten Hacken (2000), Bauer (2001, 2009), etc. *Dvandva* are addressed in Bauer (2008). See Scalise and Bisetto (2009) and Arcodia (2010) for an overview.

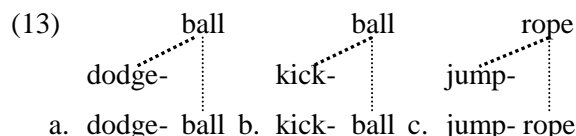
tion with closer association of its parts should be preceded by a construction with freer association at an earlier time. When and how the association changes is a matter for specialists. The assumption of such a continuum is, however, compatible with much research in grammaticalization theory, see Bybee’s (2010:136-50) analysis of Engl. *in spite of*. The important issue here is that in order to undergo this process, the individual parts of the complex expression must form catenae.

Since the *bahuvrihi* compound classes are very extensive, the discussion concentrates on four classes that contain verbal morphs:

- (12) a. VERB + NOUN
 b. VERB + PARTICLE
 c. PARTICIPLE + PARTICLE
 d. AUXILIARY + VERB

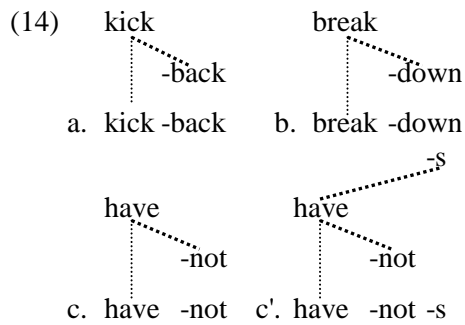
Examples for type (12a) are *dodgeball*, *kickball*, *jumprope* etc. For type (12b), one finds *kickback*, *breakdown*, *havenot* etc, and examples for type (12c) are *rundown*, *letdown*, *shutout*, etc. Type (12d) includes *musthave* and *hasbeen*.

Even though the noun *ball* depends on the verbs *dodge* and *kick* in the VPs *dodge (a) ball* and *kick (a) ball*, the noun dominates the verb in the compounds because these compounds denote specific objects or activities using these objects, and these objects are represented by *ball* and *rope*. Type (12a) exhibits the following morph dependencies:



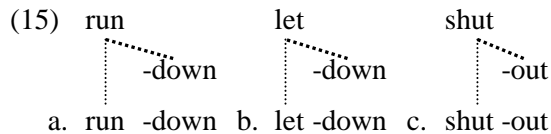
Examples (13a-c) show that the initial compound part depending on the final compound part.

Type (12b) compounds differ from type (12a) insofar as the initial compound part is seen as the root. Expressions such as *kickback*, *breakdown*, *havenot* etc. are clearly nominals, because they can be pluralized: *kickbacks*, *breakdowns*, *havenots*. It is, however, the initial compound parts that undergo plural formation, i.e. *kicks*, *breaks*, *haves*, rather than **backs*, **downs*, **nots*. Multiple *jumpropes* are still multiple *ropes*, while multiple *kickbacks* are not multiple *backs*, but multiple instances of kicking back. Hence the assumption that the initial parts form the roots, and that the plural morph vertically attaches to the initial parts is also justified when seen from semantics. The structure of type (12b) compounds is shown next:



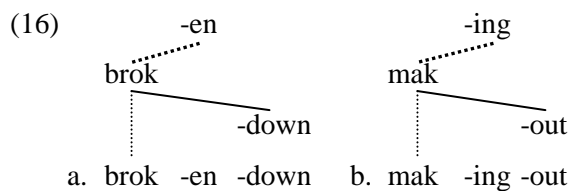
(14a-c) show the structure of *kickback*, *break-down*, and *havenot*. Example (14c') shows the plural form of (14c).

Type (12c) is a variation of type (12b). The difference lies with the form of the verb morph, which appears as a stem in (12b) but as a participle form in (12c). As long as the participle forms do not contain overt participle morphs, type (12c) compounds are seen as structured along the lines of (14):



Type (12c) compounds such as (15a-c) appear as nominal compounds because the participle is a nominal form. In the examples (13a-c), (14a-d), and (15a-c), dotted dependency edges obtain because no material can intervene between the compound parts.

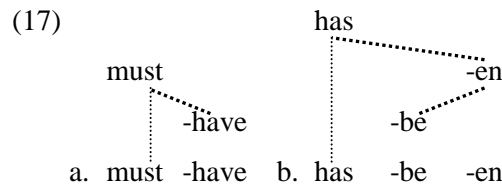
When a participle morph is present, a solid dependency edge between the verb morph and the adverb must obtain because the participle morph must intervene in the horizontal dimension:



In (16a-b), the participle morphs *-en* and *-ing* mark the expressions as nominals, but they appear in medial position. The adverbs must therefore be connected by solid dependency edges. This indicates that, in the compound continuum, the expressions in (15a-c) are located closer to the lexical endpoint of the continuum than the expressions (16a-b). More precisely, the expressions (15a-c) are at stage (11c), while the expressions (16a-b) reside at stage (11b). Since highly irregular verbs such as *run*, *let*, *shut*, etc. do not appear with a participle morph, they can lexical-

ize more readily than expressions that contain such morphs.

Finally, type (12d) compounds like *musthave* seem to be very rare. Nevertheless, their structure must be like (15):



Compare the structure (17b) with periphrasis in Section 5 below.

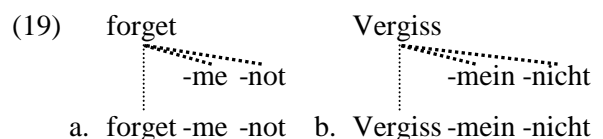
Once an expression has reached the stage (11c), it can be converted into a verb: *babysit*, *benchpress*, *bodycheck*, *bullrush*, *carpetbomb*, *crashdive*, *fieldtest*, *housebreak*, *housesit*, *proofread*, *slamdunk*, *tapdance*, etc.⁵ Many of these examples are considered to have undergone backformation; for instance, *baby-sit* is derived from *babysitter*, *carpetbomb* from *carpetbombing*, etc. Other examples such as *benchpress* or *crashdive* are seen as zero-conversion. One real-life example shows the conversion of the compound noun *cake-walk* into a verb:

(18) ...as Joseph Addai really *cakewalked* into the endzone...

This example appeared in the commentary of the Colts-Raiders game (season 2010/11, week 17), and it illustrates the productivity of the reconversion of apparent compounds to lexical morphs.

3.3 Clausal compounds

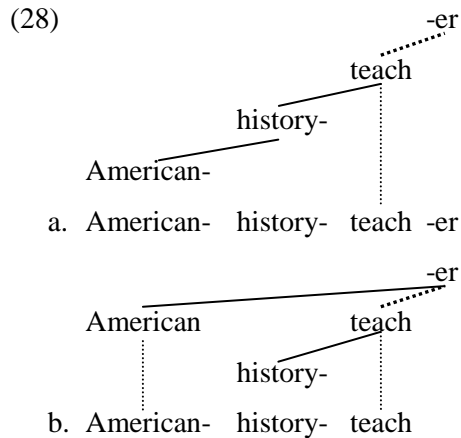
A further phenomenon of interest is compounds containing whole clauses. Well known examples include the fully lexicalized English *forget-me-not* and its German version *Vergissmeinnicht*. Both are based on imperative clauses: evidence for this assumption is the ablaut of *vergiss*, the stem of which is *vergess*. In German verbs with an /e→i/ ablaut, the ablaut version serves as the imperative form. Since the verb is the clausal root, it retains this role in compounding within its compound part. The structure of *forget-me-not* and *Vergissmeinnicht* are given next:



⁵ Contrary to spelling conventions, none of these expressions is written with a hyphen here, because these words are fully lexicalized.

quired for the correct semantic interpretation of the entire expression (and which is missing in (25a)).

A phenomenon related to bracketing paradoxes appears in compounding. Fabb (1998: 72f) calls this phenomenon “subconstituency”. He uses the example *American history teacher*:



In (28a) *American history* is traditionally seen as a subconstituent of the whole expression, which refers to a teacher of American history, the teacher not necessarily being an American. In (28b), *history teacher* is seen as a subconstituent of the entire NP, which now refers to an American teacher of history, the history not necessarily being that of America.

5 Multiple periphrases

That multiple auxiliary constructions, i.e. multiple periphrases, are a problem was acknowledged early on by Chomsky (1957: 39). He posits “affix hopping” in order to explain why the morphemes expressing aspect and voice do not appear together on the surface. Consider the next sentence:

(29) The problem has be-en be-ing discuss-ed.

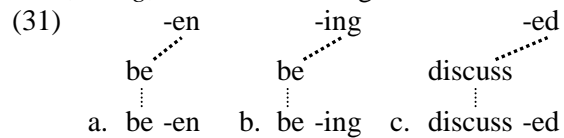
The units *has* and *-en* express perfective aspect, the first *be* and *-ing* express progressive aspect, and the second *be* and *-ed* express passive voice. The problem is that these units of functional meaning are not contiguous, because parts of other functional units intervene on the surface. For instance, *be* of the progressive unit intervenes between *has* and *-en* forming the perfective aspectual unit. Chomsky (1957: 39) proposed that the respective units are contiguous at a deeper level, and the affix of the unit “hops” over the verb of the next unit. The next example, based on Anderson (1992: 16), shows how this proposal plays out:

(30) ... (has -en) (be -ing) (be -ed) (discuss)

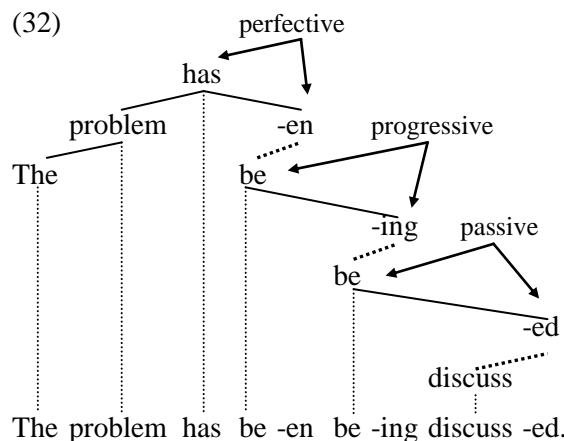
This “hopping” guaranteed that there was one level at which the respective units were contiguous, a prerequisite to establishing a semantic relationship.

In Distributed Morphology (DM) (Halle & Marantz 1993, Harley & Noyer 2003, Embick and Noyer 2001/2007, Embick 2003), affix hopping is now seen as the predecessor of “lowering” and “local dislocation”.⁶ Whatever one calls the mechanism, the core assumption is that if some unit is displaced on the surface, this unit must have moved to its surface position from a position at which it was contiguous with other units with which it forms a greater semantic unit.

Based on the concepts introduced in the previous sections, example (29) can now be reexamined. The structure of the individual words *been*, *being*, and *discussed* is given below:



In (31), the suffixes invariably dominate their lexical verbs: in (31a), *-en* dominates *be* because *be-en* distributes like a participle rather than as the infinitive. The same is true for (31c). In (31b), *be-ing* distributes like a progressive marked verb form rather than like the infinitive. The complete morph dependency structure of example (29) is now shown:



The dependency structure in (32) must first be compared to the affix hopping/lowering analysis in (30): the units expressing the respective functional meanings are present as units on the surface. *has* and *-en* (=perfective aspect), *be* and *-ing* (=progressive aspect), and *be* and *-ed*

⁶ See Sternefeld (2009: 481-88) for an overview.

(=passive voice) qualify as morph catenae. The assumption of movement is unnecessary, since the respective morph combinations are discernible in the vertical dimension (rather than the horizontal dimension).

Two issues are of importance here: 1. The analysis in (32) obeys the Bybee hierarchy (1985: 196-7), because the perfective morph catena dominates the progressive morph catena, which in turn dominates the voice catena. 2. The respective functional meanings are expressed by units that qualify neither as constituents nor as words. As a corollary, the morph catena is – like its syntactic equivalent – a unit of meaning, available on the surface.

6 Conclusion

This paper has argued that morphological structure can be captured in dependency grammar by extending the notion of the catena from syntax into morphology. The fact that no additional concepts are necessary – and thus that morphology plays out as syntax inside words is desirable. Section 2 introduced the morph catena as A MORPH OR COMBINATION OF MORPHS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. The two relevant dependency relationships between morphs were then established: intra-word dependencies obtain between morphs contained in the same word; they are based on distribution. Inter-word dependency, or government, plays out between a morph and a word, so that the morph licenses the appearance of the word. Using these two concepts, morphs can be connected into catenae regardless of the complexity of the structure. It has also been demonstrated that this account can accommodate non-concatenative morphology (although these phenomena were not in focus).

The main message of this paper is that dependency grammar should and can make more of morphology. At present, dependency grammar operates in syntax. However, the same meaning can be encoded at different levels in different languages. For instance, causative constructions are periphrastic in English and German, but morphological in Japanese. In order to compare languages, the concentration on syntax alone is insufficient; rather it is necessary to provide a system that enables a fluid transition of description from syntax to morphology and back. This is possible if dependency relationships are seen as operating not only in syntax, but also in morpho-syntax and morphology. The catena concept al-

lows for a fluid transition between syntax, morpho-syntax, and morphology, and thus simplifies the theoretical apparatus.

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