Constructions are catenae: Construction Grammar meets Dependency Grammar*

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Abstract

The paper demonstrates that dependency-based syntax is in a strong position to produce principled and economical accounts of the syntax of constructs. The difficulty that constituency-based syntax has in this regard is that very many constructs fail to qualify as constituents. The point is evident with the box diagrams and attribute value matrices (AVMs) that some construction grammars (CxGs) use to formalize constructions; these schemata often represent fragments rather than constituents. In dependency-based syntax in contrast, constructions are catenae, whereby a catena is a chain of words linked together by dependencies. The catena is a novel but well-defined unit of syntax associated with dependency grammar (DG). The constructs of CxGs are more amenable to analyses in terms of the catenae of dependency-based syntax than to analyses in terms of the constituents of constituency-based syntax.

Keywords: *catena, Construction Grammar (CxG), constructs, constructions, Dependency Grammar (DG)*

1. What happened to the trees?

Much of the canonical literature on Construction Grammar (CxG) lacks trees.[1] What one finds occasionally instead are box diagrams (e.g. Goldberg 1995: 48; Michaelis and Lambrecht 1996: 225; Kay and Fillmore 1999: 20; Croft 2001: 212; Kay 2002; Michaelis 2003: 294; Michaelis 2004; Bergen and Chang 2005), or more recently, AVMs (Attribute Value Matrices) (Sag 2010, Michaelis in

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1. There are exceptions to this statement. Culicover and Jackendoff's (1999) account of the *the more X the more Y construction*, for instance, contains a number of trees and is generally included in the canon of CxG literature.

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press). These schemata show the key semantic and syntactic traits of the constructions at hand, e.g. situation frames, valence requirements, the linking of thematic roles with syntactic categories/roles. Some of the schemata also convey minimal information about structure. For instance if box diagrams are being used, the greatest box of a diagram might represent a node in structure and smaller boxes contained inside that greater box indicate branching. Beyond the occasional box diagram or AVM however, most CxGs provide little guidance as to how one might view the structure of constructs and thus of sentences in general.

One explanation for the lack of concrete analyses of sentence structure in many canonical CxGs is that the tool used to show sentence structure, i.e. trees, is associated with derivational theories. CxGs of course eschew transformations and derivations, arguing instead that constructions are learned individually and are thus necessarily understood in terms of representations. Trees suggest a Fregean view of meaning compositionality, whereby smaller units are combined to create larger units, the result being a whole, the meaning of which is taken to be a function over the meaning of its parts. CxGs at least in part reject this view of how meaning is generated and conveyed. They emphasize instead that constructions have *gestalt* properties (Lackoff 1987: 538), i.e. the whole is often quite different from the sum of the meanings of the parts that make up the whole. Because trees seem to suggest that meaning is compositional in the Fregean sense, it is perhaps not a surprise that CxGs rarely employ them.

Another explanation for the paucity of tree structures, and one that weighs more for us, is that the concrete manifestations of constructions, i.e. the constructs, often do not lend themselves to analyses in terms of constituents. The very nature of constructs is that they cannot be broken down into their constituent parts in such a manner that allows consistent compositional meaning assignment to these parts. The motivation to render these constructs as tree structures is therefore lacking. Trees, namely, show constituent structure, not construct structure. The word combinations that make up many constructs will not form any recognizable unit of structure in the trees that show constituent structure. Langacker expresses a similar point. He sees problems with "classical constituents" (1997: 13) insofar they do not exhaust "conceptual and phonological groupings that occur and are relevant to grammatical structure" (1997: 14).[2]

The inability of trees to provide insights into the structure of constructs can be seen with idioms. The fixed words of many idioms do not form constituents,

2. Further, he argues that "classical constituents" fail to account for phenomena such as parenthetical insertion (1997: 23f), discontinuities (1997: 24f), scope inversion (1997: 25f), and overlapping constituents (1997: 27–30). In Langacker (2008: 208), he also demonstrates the difficulties for constituency with the idiomatic construction *take for granted that*.

e.g. *keep tabs on X*, *take hold of X*, *throw X to the wolves*, *give X a hand*, *send X to the doghouse*, *step on X's toes*, *take X's word for it*, *pull X's leg*. The argument marked by X in each of these examples is outside of the idiom, which means that the fixed words of the idiom can in no way be viewed as forming a constituent. The tree structures of these idioms would therefore not be so insightful, for the fixed words form no recognizable unit of syntax. Two idiomatic expressions that figure prominently in the literature illustrate the point further, i.e. the *What is X doing Y?* construction (Kay and Fillmore 1999) and *the more X the more Y* construction (Culicover and Jackendoff 1999). The fixed elements of these idiomatic expressions cannot be viewed as forming constituents no matter the theoretical approach that one assumes (derivational or representational), since the arguments marked by X and Y necessarily interrupt the fixed words of the idiom constructs. Thus given the INability to analyze many constructs in terms of constituents, one can perhaps understand why many CxGs see little value in producing trees that reflect constituent structure.

In our view however, the lack of concrete explorations into sentence structure is a shortcoming of the constructionist's enterprise. The constructs that form sentences are clearly NOT grouped in an arbitrary manner, but rather they are arranged so that structure can be acknowledged and meaning conveyed. In this area we agree with Holmes and Hudson (2005), who see great potential for a marriage of the theoretical tenets and goals of CxGs with a dependency-based analysis of sentence structure.[3] Dependency grammars (DGs) view the constituent structure of sentences much differently than constituency grammars, and we believe that this alternative take on sentence structure is strongly compatible with the theoretical stances, empirical observations, and practical goals of CxGs.

In particular, we defend in this paper the following two claims:

Claim 1
Constructions are *catenae*.

Claim 2
A lexically fixed construct can be broken up by virtue of its co-occurrence with (a) lexically less fixed construct(s). The words of the more fixed construct always form a catena together with the words of the less fixed construct(s).

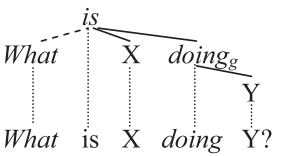
3. While the message delivered here overlaps to an extent with Holmes and Hudsons' (2005) paper, there are significant differences between the two accounts. Holmes and Hudson's approach is a Word Grammar account. Our DG differs from Word Grammar in significant ways. Above all, our system rejects the networks Word Grammar posits in surface syntax. For us, syntactic structures are trees (not networks). Furthermore, Holmes and Hudson do not explicitly acknowledge the role of catenae (although catenae are certainly present in the networks they assume).

The catena (Latin for 'chain', plural *catenae*) is a unit of syntax (and morphosyntax) that dependency-based systems are uniquely capable of acknowledging. Following Osborne et al. (2013), the catena is defined as A WORD OR A COMBINATION OF WORDS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. This definition identifies any dependency tree or any subtree of a dependency tree as a catena.[4]

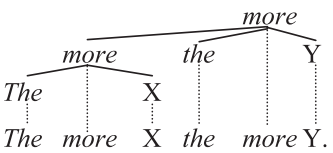
O'Grady (1998) was the first to employ the catena concept. He observed that the words of idioms form catenae, although he used the term "chain" (instead of "catena") to denote the relevant word combinations. Osborne (2005, 2006, 2007, 2008), Groß and Osborne (2009), and Groß (2010)—who also employ the term "chain" instead of "catena"—develop the concept further, showing that its applicability reaches far beyond the syntax of idioms to a wide variety of phenomena. Osborne et al. (2013) rename the concept "catena" in order to avoid confusion with other uses of the term "chain" (i.e. the confusion that arises due to the much different chain notions in derivational theories and in set/graph-theory).

The catena is a much more inclusive unit of syntax (and morphosyntax) than the constituent, and it is therefore better suited to serve as the fundamental unit of meaning and syntax for CxGs and otherwise. Constructions are amenable to analyses in terms of catenae, but much less so to analyses in terms of constituents. As a preliminary illustration of this point, the dependency trees of a *What is X doing Y* construct and a *the more X the more Y* construct are given.

(1)



(2)



4. In a representational, strictly endocentric constituency-based system, the catena can be defined as A WORD OR A COMBINATION OF WORDS THE PROJECTIONS OF WHICH ARE CONTINUOUS WITH RESPECT TO DOMINANCE. The problem with this constituency-based definition of the catena is that it is reliant on assumptions about sentence structure to which many of the established constituency-based frameworks do not subscribe, e.g. all structure must be endocentric and null elements do not exist. For representational constituency grammars that reject exocentric structures however, this constituency-based definition can identify the same word combinations as catenae as our dependency-based definition.

The dashed dependency edge and the *g*-subscript in (1) indicate *rising*. Rising is the means by which the current DG addresses discontinuities; it is discussed below in Section 7.

The important thing to acknowledge about (1)–(2) in the current context is that the words of the idiomatic constructs form catenae, i.e. they are word combinations that are continuous with respect to dominance, which means they form subtrees. The words *what*, *is*, and *doing* in (1) are top-down continuous; together they form a catena. The words *the*, *more*, *the*, and *more* in (2) are also top-down continuous; together they form a catena. The arguments of these constructs (i.e. X and Y) appear outside of these catenae. The importance of these observations becomes evident when one acknowledges that these word combinations can in no way be seen as forming constituents.

The following outline provides an overview of the paper:

1. What happened to the trees?
2. Compatibility
3. Dependency-based syntax
4. Catenae
   - 4.1 The concept
   - 4.2 Idioms
   - 4.3 More on idioms
   - 4.4 Ellipsis
5. Syntactic constructions
   - 5.1 Major syntactic constructions
   - 5.2 Periphrastic verb constructions
   - 5.3 Argument-structure constructions
6. Formalizing constructions
7. Intersecting constructs
8. The more X the more Y
9. Catenae in cognition
10. Conclusion

Since the main goals are to present the catena concept and to defend the central claims given above, this paper focuses on the syntactic form of constructions and their concrete manifestations as constructs. In so doing, the paper largely overlooks the semantic and pragmatic factors that are bound to syntactic form. While this practice may be contrary to the constructionist's agenda, which takes form and meaning to be inseparably intertwined, doing so is necessary due to the limitations of what can be accomplished in a single paper. Furthermore, we remain at the level of words, meaning that we do not consider the manner in which catenae reach into words to link morphs together. This limitation is also necessary due, again, to what can be reasonably accomplished in a single paper.

2. Compatibility

The DG that we pursue is consistent with a long tradition of dependency-based syntax and grammar (e.g. Tesnière 1959; Hays 1964; Robinson 1970; Kunze 1975; Matthews 1981; Mel'čuk 1988; Schubert 1988; Starosta 1988; Hudson 1984, 1990, 2010; Lobin 1993; Pickering and Barry 1993; Engel 1994; Jung 1995; Heringer 1996; Groß 1999; Eroms 2000; Kahane 2000; Tarvainen 2000; Ágel et al. 2003, 2006). While there are certainly major differences between DGs, the trait that makes them DGs is the fundamental stance that syntactic units are organized according to the dependency relation, not according to the constituency relation—see Section 3. Beyond this one major unifying trait, DGs vary in significant ways. They can be derivational or representational, mono- or multistratal, construction or rule-based. Our DG is representational, monostratal, and (at least in part) construction-based.

Our DG shares the major theoretical tenets espoused by canonical CxGs. It rejects the modular view of grammar. It sees the human faculty for language consisting of general cognitive abilities (and thus rejects the Innateness Hypothesis). It views constructions as grouped into inheritance classes, whereby specific constructions inherit traits of more general constructions. It assumes that constructs frequently overlap and intersect and that any given sentence usually contains numerous varying constructs. It does NOT focus almost exclusively on "core" grammar and in so doing, relegate numerous phenomena to the "periphery" as being somehow anomalous and therefore less worthy of analysis and exploration. It rejects the stance that given a constituent-based system, meaning is strictly compositional in the Fregean sense.[5] Constructions have *gestalt* properties (Lackoff 1987: 538), i.e. the meaning of the whole is often quite different from the meaning of the sum of the constituent parts.

Two areas where our DG overlaps with canonical CxGs are particularly important for the discussion below. Like many CxGs (Lackoff 1987: 465; Goldberg 1995: 7; Croft 2001: 17; Goldberg and Jackendoff 2004: 532; Tomasello 2006a: 3–4), our system rejects the concept of autonomous syntax. It assumes instead a lexicon-syntax continuum, whereby some constructions are deemed more lexical than syntactic in nature, and others more syntactic than lexical.

(3) Lexicon ⟷ Syntax

Constructions with fixed words, e.g. idioms, appear left of center on this continuum, whereas constructions that have a fixed structure but not necessarily

5. The qualification ". . . given a constituent-based system" is important here. Our stance is that Frege's principle of compositionality cannot be maintained if one assumes a constituent-based system. One's ability to acknowledge the compositionality of meaning increases, however, given a catena-based system. The catena becomes the fundamental meaning-bearing unit.

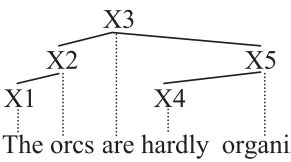
fixed words, e.g. subject-aux inversion, are located right of center on the continuum. The extent to which a given construction involves fixed words and/or fixed structures helps determine whether it should be located to the left or right of center on the continuum.

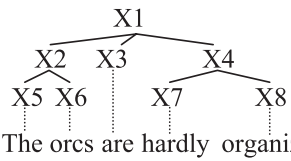
The second aspect of our approach that is particularly important for the discussion below is the distinction between *constructions* and *constructs* (Kay & Fillmore 1999: 2–3; Diewald 2009: 450). This is the *type vs. token* distinction that is so central for the study of theoretical linguistics (e.g. phoneme vs. phon, morpheme vs. morph, lexeme vs. word form). A construction (= type) is an abstract entity that is stored in the mental lexicon of a speaker, whereas a construct (= token) is a concrete manifestation of a construction that appears in the actual language of a speaker. The title of this paper (= Claim 1) references constructions, not constructs. Indeed, while constructions always qualify as catenae, constructs often fail to qualify as catenae because they are interrupted by other constructs (= Claim 2).

3. Dependency-based syntax

Since most CxGs are constituency-based, a brief discussion of the distinction between dependency- and constituency-based systems is necessary. Explications of the dependency vs. constituency distinction emphasize that dependency is a strict *mother-daughter* relation (≈ head-dependent relation).[6] Constituency, in contrast, is a meronomic *part-whole* relation. The two ways of construing syntactic structure are illustrated with the following trees:

(4)





6. DGs are at times inconsistent in their use of these terms. To reduce confusion, we employ the terms *mother*, *daughter*, *head*, and *dependent* consistently according to the following definitions:

   MOTHER: The one word that immediately dominates a given word
   DAUGHTER: A word that a given word immediately dominates

   HEAD: The word that immediately dominates a given constituent (= complete subtree)
   DEPENDENT: A constituent that is immediately dominated by a given word

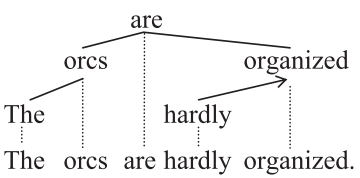
The constituency tree (4b) is the direct translation of the dependency tree (4a); it therefore lacks a finite VP constituent—dependency-based syntax is by its very nature incapable of acknowledging the traditional binary division that is at the core of most constituency grammars (e.g. S → NP + VP).

The syntactic units in (4a) are organized according to the one-to-one dependency relation; each word in the string corresponds to one and only one node in the structure. The constituency relation illustrated in (4b), in contrast, is a one-to-one-or-more relation; each word in the string corresponds to one or more nodes in the structure. There are five words in (4a) and five nodes in the dependency structure. In contrast, there are five words in (4b) but eight nodes in the constituency structure there. Given this word-to-node ratio, it should be apparent that DG structures are minimal compared to their constituency grammar counterparts.[7]

The dependency structure of a given sentence is determined in the same manner that one determines the constituency structure for that sentence. A number of diagnostics are employed, for instance constituency tests (topicalization, clefting, pseudoclefting, proform substitution, answer fragments, etc.). Tree (4a) is the dependency structure that best matches the results of these constituency tests. Similarly, tree (4b) is a constituency structure that matches the results of these tests as well. Notice, for example, that both (4a) and (4b) show the participle phrase *hardly organized* as a constituent (= a complete subtree) and that the named constituency tests largely confirm it to be a constituent.

The one-to-one dependency relation provides an opportunity. The words themselves can be plugged directly into the nodes of the hierarchy. Tree (4a) is rendered as (5):

(5)



The dependency hierarchies produced below employ this convention. The words and the dependency edges that connect the words are all that exist. A word is a node, and a node is a word. Concerning the arrow, we employ a convention similar to the one employed by Engel (1977) and Eroms (2000: 85–86), whereby an arrow dependency edge marks an adjunct (although Eroms has the

7. It is of course fallacious to maintain that simpler structures are better than more complex structures simply by virtue of the fact that they are simpler. If, however, the simpler structures are equally as capable as the more complex structures at addressing the phenomena under scrutiny, then the simpler structures ARE better. This is Occam's Razor.

arrow pointing in the opposite direction). Our arrows point toward the governor (≈ head) of the adjunct. Thus the arrow in (5) indicates the status of the measure adverb *hardly* in (5) as a non-argument of the predicate *are organized*. The key difference between arguments and adjuncts is that an argument is selected by its predicate, whereas the relationship is reversed for adjuncts, i.e. an adjunct selects its governor. The direction of the arrow is intended to signify this relationship, i.e. that the direction of selection is running opposite "normal".[8]

Despite the paucity of structure, dependency hierarchies inherently convey significant information that constituency structures do not convey. Comparing (4a, 5) with (4b), one sees that the head-dependent relation is immediately visible in (4a, 5). One sees that *orcs* is the head of *the*, that *organized* is the head of *hardly*, and that *are* is the head of *the orcs* and *hardly organized*. The head-dependent relation is not evident in (4b), in contrast.[9] One cannot see whether *the* or *orcs* is the head of *the orcs*, whether *hardly* or *organized* is the head of *hardly organized*, or whether *the*, *orcs*, *are*, *hardly*, or *organized* is the head of the entire sentence. In order for constituency trees to convey this information, the category labels can be included on the phrase markers. Such augmentation introduces additional complexity into the grammar in the form of category phrasal nodes.

These few brief comments about the distinction between dependency- and constituency-based grammars will have to suffice. The heavy use of dependency trees below should help bridge gaps in understanding. For the reader who desires more background on the distinction, we recommend one or more of the numerous explications of the differing views of sentence structure (e.g. Baumgärtner 1970; Anderson 1979: 92–93; Matthews 1981: Ch. 4; Engel 1994: 23; Mel'čuk 1988: 12; Jung 1995: 15; Elst and Habermann 1997: 10; Eroms 2000: 75; Tarvainen 2000: 4).

4. Catenae

The following four subsections examine the word combinations that form catenae. The discussion reproduces some of the evidence given by O'Grady (1998), Osborne (2005) and Osborne et al. (2013) in support of catenae. This evidence demonstrates the existence of catenae and reveals the fundamental role that they play in syntax and grammar.

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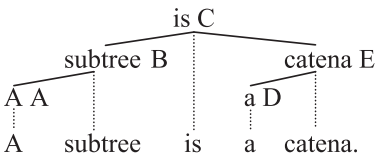
8. Since the argument vs. adjunct distinction does not bear directly on the greater analysis of constructions in terms of catenae, we do not discuss the matter further here.
9. An editor objects here that tree (4b) is unlike the trees that most constituency-based systems (derivational or representational) would assume for sentence (4). We agree. Tree (4b) is the direct translation of tree (4a) (dependency → constituency) and as such, it is intended to facilitate the comparison of the dependency vs. constituency distinction at an elementary level. This situation does not diminish our point. If, for instance, a finite VP were included in (4b), the necessity to include node labels (to distinguish heads from dependents) would still exist.

4.1. *The concept*

The catena has been defined as A WORD OR A COMBINATION OF WORDS THAT IS CONTINUOUS WITH RESPECT TO DOMINANCE. According to this definition, any given dependency tree or any subtree of a dependency tree is a catena.

(6)

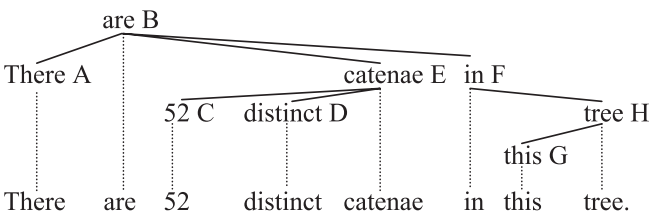


The capital letters serve to abbreviate the words. There are 15 distinct word combinations in (6) that qualify as catenae: A, B, C, D, E, AB, BC, CE, DE, ABC, BCE, CDE, ABCE, BCDE, and ABCDE. Note as well that there are 16 distinct non-catena word combinations in (6): AC, AD, AE, BE, BD, CD, ABE, ABD, ACE, ACD, ADE, BCD, BDE, ABCD, ABED, and ACDE. To increase understanding, we can examine some of the specific combinations. The word combination AB, for instance, is a catena because B immediately dominates A. The word combination AC, in contrast, fails to form a catena because C does not immediately dominate A (nor vice versa) as B intervenes. The word combination BCE is a catena because C immediately dominates both B and E, whereas the word combination BCD is not a catena because D is not immediately dominated by B or C.

As the number of words increases, the percentage of non-catenae word combinations increases. There is a logical reason for this tendency. If a sentence only contains few words, then the number of word combinations that qualify as catenae will outnumber or equal the number of combinations that do not qualify as catenae. For instance in *John came home*, the catena *came home* already constitutes one third of the possible combinations in which *home* can participate. The same holds for *John came*. As the number of words increases, the number of combinations that do not qualify as catenae increases dramatically, but the number of combinations that actually qualify as catena will exhibit a much lower increase.

These numbers are illustrated with the following example, which contains 52 distinct catenae:

(7)

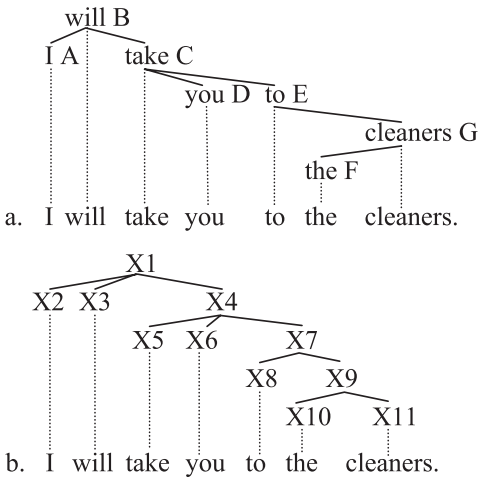


All 52 of these catenae are listed here: A, B, C, D, E, F, G, H, AB, BE, BF, CE, DE, FH, GH, ABE, ABF, BCD, BDE, BEF, BFH, CDE, FGH, ABCE, ABDE, ABEF, ABFH, BCDE, BCEF, BDEF, BEFH, BFGH, ABCDE, ABCEF, ABDEF, ABEFH, ABFGH, BCDEF, BCEFH, BDEFH, BEFGH, ABCDEF, ABCEFH, ABDEFH, ABEFGH, BCDEFH, BCEFGH, BDEFGH, ABCDEFH, ABCEFGH, ABDEFGH, and ABCDEFGH. The total number of distinct non-catena in (7) is 203, e.g. AD, CG, BDH, etc. The number of distinct non-catena word combinations in a given tree is calculated by subtracting the total number of catenae (here 52) from the number of all possible word combinations for that tree (here $2^8 - 1 = 255$).[10] The calculation is therefore $255 - 52 = 203$. Thus while there are a large number of catenae word combinations in (7), there are many more (almost four times more) non-catena word combinations.

The ratio of non-catena to catena is important, because it demonstrates that the catena is a quite exclusive unit of syntax. A unit of grammar is *exclusive* if relatively few of the possible word combinations actually qualify as the named unit. For CxGs, this means that if one requires a given construct to be a catena, one has excluded a large number of word combinations from consideration as candidates for that construct. In (7), 203 word combinations are excluded from qualifying as catenae, whereas "only" 52 word combinations are included as catenae. The number 52 may seem like a lot, especially if seen from the vantage point of constituent-based systems. This impression is due to the fact that the constituent is a more exclusive unit than the catena.

The next example compares the number of catenae to the number of constituents across dependency and constituency structures:

(8)



10. The formula $2^n - 1$ (where n = the number of words) is used to calculate the total number of distinct word combinations for a given structure.

The constituency tree (8b) is again the direct translation of the dependency tree (8a), which means it lacks a finite VP constituent—see example (4b). Counting the catenae in (8a) individually, one arrives at 33: A, B, C, D, E, F, G, AB, BC, CD, CE, EG, FG, ABC, BCE, CDE, CEG, EFG, ABCD, ABCE, BCDE, BCEG, CDEG, CEFG, ABCDE, ABCEG, BCDEG, BCEFG, CDEFG, ABCDEG, ABCEFG, BCDEFG, and ABCDEFG. In the constituency tree (8b) in contrast, there are only 11 constituents. In this case then, the number of catenae is three times the number of constituents. The ratio of catenae to constituents (33: 11) shows the catena indeed to be more inclusive than the constituent. The catena is capable of including many word combinations that the constituent cannot include. In other words, the constituent excludes many word combinations that qualify as catena. Part of the message delivered below is that those word combinations excluded from qualifying as constituents but included as catenae can play an important role in syntactic analysis.

The criteria that define catenae and constituents are considered next. A word combination must fulfill three criteria to qualify as a constituent: 1) The words of the combination must be adjacent, i.e. they must form a string;[11] 2) the words of the combination must be continuous in the vertical dimension, i.e. they must form a *catena*; and 3) the words of the combination must include all the words that they dominate.[12] A unit that satisfies the third criterion is called *complete*. In combination, these three criteria define a very exclusive concept. Logically then, one can expect fewer word combinations to satisfy all three criteria than to satisfy just one criterion. Since the catena has to satisfy just the second criterion, it is clearly more inclusive than the constituent.

A related point concerning constituents and catenae should also be acknowledged. Because a word combination qualifying as a constituent fulfills all three criteria, it must necessarily fulfill the second criterion. This means that all constituents are catenae, but obviously, not all catenae are constituents. In

11. An anonymous reviewer objects here that according to some, the words of a constituent need not form a string (e.g. Wells 1947; McCawley 1982). While we acknowledge that some have posited "discontinuous constituents", we think that most theories of grammar understand a constituent to be a continuous string of words. For in order for one to acknowledge discontinuous constituents, one has to accept the legitimacy of tree structures that contain crossing edges. Most grammars choose to avoid crossing edges, assuming some sort of movement or feature passing mechanism instead, e.g. the slash feature of GPSG/HPSG.
12. Langacker (1997: 4) states that "Constituents of the 'classical' variety emerge when a particular kind of conceptual grouping happens to be symbolized by a particular kind of phonological grouping". Since dependencies are seen as primary and are represented in cognitive grammar (1997: 3), dependencies (or the units they form, i.e. catenae) can be viewed as "conceptual groupings". Criterion 1 therefore refers to Langacker's "phonological grouping", and Criterion 2 to his "conceptual grouping". Condition 3 is a further requirement, but is absent from Langacker (1997).

other words, THE CONSTITUENT IS A SUBTYPE OF CATENA. This fact entails that the constituent is a derived concept. The string and the catena, in contrast, are basic.

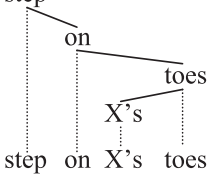
The obvious exclusivity of the constituent contributes to the difficulties constituent-based theories face when addressing issues such as idiom formation and ellipsis. The greater inclusivity of the catena, by contrast, suggests that it, i.e. the catena, is better suited to serve as the fundamental unit of syntax (and morphosyntax). The following two subsections reproduce some of the evidence from O'Grady (1998), Osborne (2005), and Osborne et al. (2013) that support the catena concept.

4.2. *Idioms*

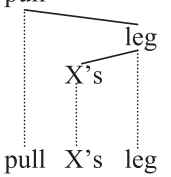
Explorations of idioms (e.g. Fillmore et al. 1988; Nunberg et al. 1994; O'Grady 1998; Horn 2003) ascertain that idioms are a heterogeneous bunch. Some idioms can be partitioned into meaning parts (e.g. *keep tabs on*), whereas other idioms are indivisible in this sense (e.g. *kick the bucket*). Despite such differences, all idioms are the same insofar as they are stored as catenae. In other words, idioms appear as catenae on the lexicon-syntax continuum. Crucially however, there are very many idioms that clearly are NOT stored as constituents. The importance of these facts for CxGs should be apparent, since these grammars have traditionally emphasized the importance of idioms and the idiom-like nature of many constructions (e.g. Fillmore et al. 1988: 504; Goldberg 1996: 31; Croft 2001: 15; Goldberg and Jackendoff 2004: 534; Tomasello 2006a: 3).

Many idioms include the verb and the object or oblique nominal, but exclude the possessor of the nominal:

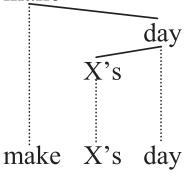
(9) step



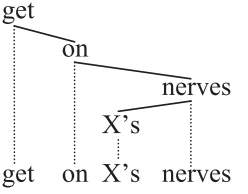
(10) pull



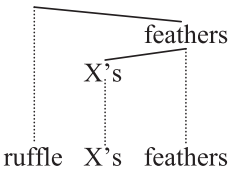
(11) make



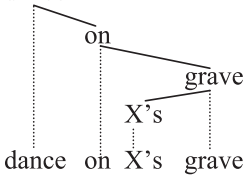
(12) get



(13) ruffle

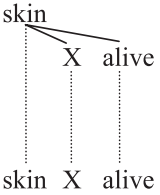


(14) dance

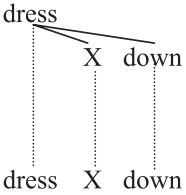


Other idioms include the verb and a resultative or depictive expression, but exclude the object:

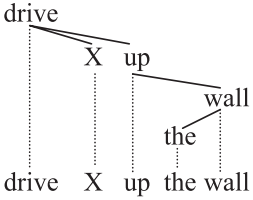
(15) skin



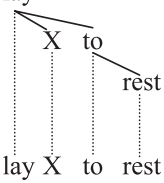
(16) dress



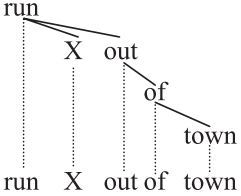
(17) drive



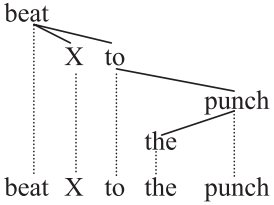
(18) lay



(19) run

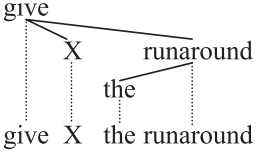


(20) beat

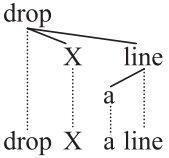


Still other idioms include the verb and the second object of a ditransitive structure at the same time that they exclude the first object:

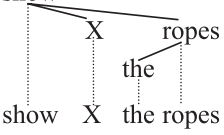
(21) give



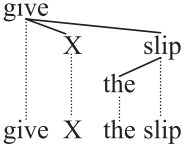
(22) drop

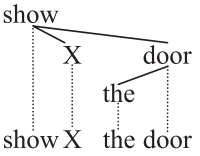


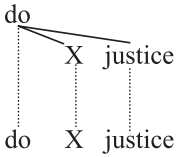
(23) show



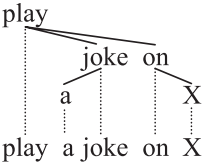
(24) give

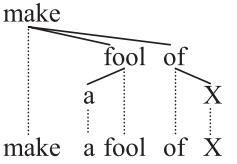


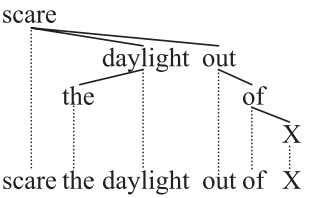
(25) 

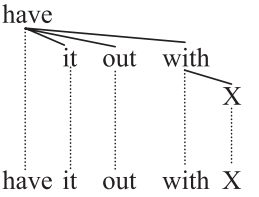
(26) 

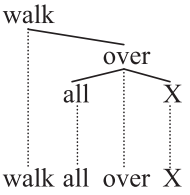
And many idioms include the verb, perhaps an object, and a preposition, but exclude the object of the preposition:

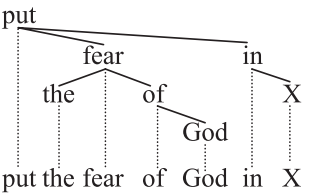
(27) 

(28) 

(29) 

(30) 

(31) 

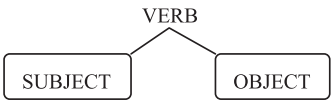
(32) 

In each of the examples (9–32), the argument marked by the X is outside of the idiom. This means that the words of the idiom can in no way be construed as forming a constituent. These words do, however, form a catena. As a catena, each is a concrete unit of syntax.

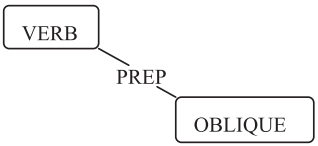
The significance of this insight is substantial for the theory of idioms and syntax in general. Semantic units of meaning now correspond to concrete units of syntax, namely to catenae. Consider by contrast how many constituent-based theories have addressed idioms like (9–32). They assume that such idioms are stored as incomplete constituents in the lexicon, since certain positions inside many of these idiom constituents are lexically free, e.g. the positions marked by X in the examples above. Such an approach begs a further question though, namely: How does the grammar limit or determine which sub-constituents inside an idiom constituent are or can be free? The approach here in terms of catenae is not challenged by this question. The words forming an idiom must be stored as a catena, whereby the catena is a concrete unit of syntax.

An important prediction resulting from this analysis of idioms is that non-catena word combinations should never be stored as idioms. That is, if a given word combination cannot be stored as a catena, it cannot be a candidate for an idiom. The following constellations provide four illustrations of this point:

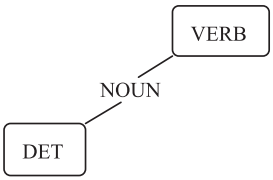
(33) a.



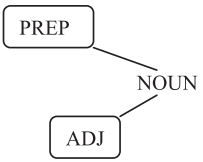
b.



c.



d.



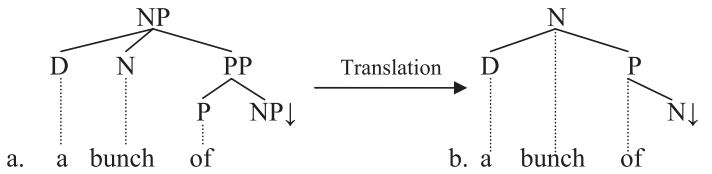
Idioms consisting of a subject and an object to the exclusion of the verb in a constellation like (33a) do not exist. Similarly, idioms consisting of a verb and an oblique object to the exclusion of the preposition in a constellation like (33b) also do not exist. Further, idioms consisting of a determiner and a verb to the exclusion of the noun in a constellation like (33c) are non-existent as well. And finally, idioms consisting of a preposition and an adjective to the exclusion of the noun in a constellation like (33d) are also not to be found. The word combinations indicated in (33a–d) never form idioms because they never qualify as catenae.

4.3. *More on idioms*

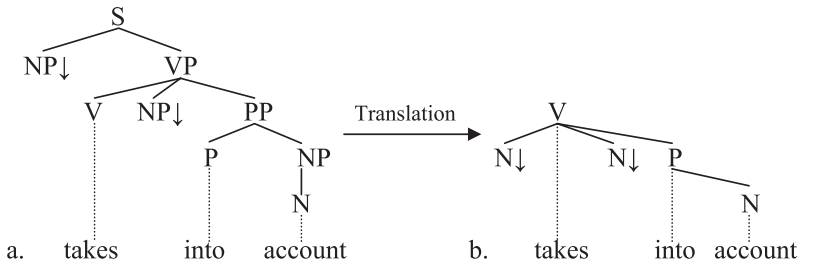
Some further comments about idioms in constituency-based systems should be insightful at this stage. An anonymous reviewer has pointed out that the lexical TAG (= Tree Adjoining Grammar) of Abeillé and Schabes (1989) produces an analysis of idioms similar to our account in the previous section. Abeillé and Schabes see idioms stored as single semantic units, as do we. The key difference between their account and ours, however, is the dependency vs. constituency distinction. Abeillé and Schabes see idioms projecting constituency-based structures, whereas our dependency-based idioms do not project structure in this sense, but rather they ARE the structure. We follow Joshi and Rambow (2003) in this area, who demonstrate that the constituency-based structures of TAG are easily translated into dependency-based structures and that TAG principles are equally valid across the two representation formats.

The difference between the constituency-based TAG analysis and our dependency-based analysis is represented schematically with the following trees. Abeillé and Schabes' constituency-based trees for two representative idioms (1989: Figure 10 and Figure 12) are shown on the left, and the dependency-based translations of these trees are shown on the right (irrelevant details omitted):

(34)



(35)



The tree structures for the idioms *a bunch of* and *takes into account* are shown. The lexicalized TAG trees on the left show how the idioms project skeletal structure, including the NP nodes. The NP↓ positions are to be occupied by the argument(s) of the idioms. In this manner, the fact that idioms are single semantic predicates that take arguments is reflected in the syntax.

The trees on the right show what remains after the constituency-based TAG trees have been translated to the corresponding dependency-based trees. The translation involves reducing the projections of a word down to a single node. Thus, for instance, the three nodes projected by the finite verb *takes* in (35a) (i.e. V, VP, and S) are compacted down to the one node V, and this node appears in the position of S.[13] The dependency-based trees convey the same semantic and syntactic information as the constituency-based trees. The dependency-based trees are, however, minimal, containing significantly fewer nodes and

13. Most modern grammars reject the traditional exocentric binary breakdown of the sentence, i.e. S → NP + VP, where S is a category distinct from N(P) and V(P). In this regard, more accurate, endocentric renditions of the traditional division acknowledge the root node as a projection of the finite verb, e.g. TP → DP + T′, IP → NP + I′.

edges. More important in the current context is the fact that dependency-based trees enable one to see catenae. One sees clearly that the words of the idioms qualify as node combinations that are continuous along the vertical axis. The extra structure of constituency-based trees obscures this fact.

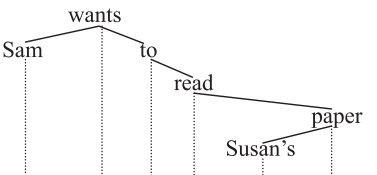
There are a couple of points to take away from the comparison. One is that dependency-based structures are minimal compared to their constituency-based counterparts; another is that certain constituency-based systems (such as a lexicalized TAG) can actually also acknowledge idiom catenae and catenae in general—see footnote 4; and a third is that the extra structure associated with constituency-based systems obscures the presence of catenae and hence may have prevented constituency-based systems from recognizing and acknowledging the catena unit.

4.4. *Ellipsis*

The second major source of empirical support for the catena comes from ellipsis. Osborne (2005) and Osborne et al. (2013) demonstrate that the elided material of ellipsis must always correspond to a catena. Crucially though, this material often does NOT correspond to a constituent. The point is demonstrated here with respect to four ellipsis mechanisms: answer fragments, gapping, pseudogapping, and stripping. Note that Croft (2001: 280) views ellipsis mechanisms as constructions.

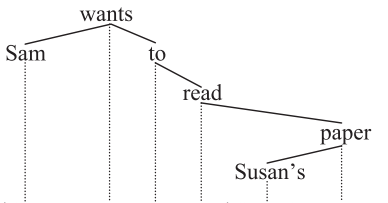
The elided material of answer fragments corresponds to a catena, but often not to a constituent:

(36)



a. Who wants to read Susan's paper? Sam ~~wants to read Susan's paper~~.
b. What does Sam want to read? ~~Sam wants to read~~ Susan's paper.
c. Whose paper does Sam want to read? ~~Sam wants to read~~ Susan's ~~paper~~.
d. What does Sam want to do? ~~Sam wants to~~ Read Susan's paper.

The answers on the right show what remains and what has been elided. In each case, the struck-through material qualifies as a catena. When the elided material fails to qualify as a catena, the result is robustly unacceptable:



e. What does Sam want to do with Susan's paper? *~~Sam wants to~~ Read ~~Susan's paper~~.

f. What of Susan's does Sam want to read? *~~Sam wants to read Susan's~~ Paper.

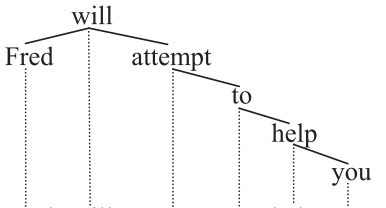
g. How does Sam view reading Susan's paper? *~~Sam~~ Wants ~~to read Susan's paper~~.

h. What does Sam desire to do with Susan's paper? *~~Sam~~ Wants to read ~~Susan's paper~~.

The struck-through material now no longer qualifies as a catena, so the robust unacceptability of such answer fragments is predictable. A word of caution is warranted, though. The catena requirement on the elided material of answer fragments is a necessary condition, but not a sufficient one, which means there are numerous conceivable answer fragments that have the elided material as a catena but that are nevertheless unacceptable.

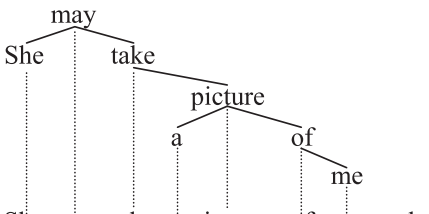
The elided material of gapping also always corresponds to a catena, as the following data illustrate:

(37)



	Fred	will	attempt	to	help	you, and
a.	Tom					me.
b.	Tom			to	help	me.
c.	*Tom			to	ignore.	
d.	*Tom		try	to	ignore	
e.	*Tom		try			me

(38)

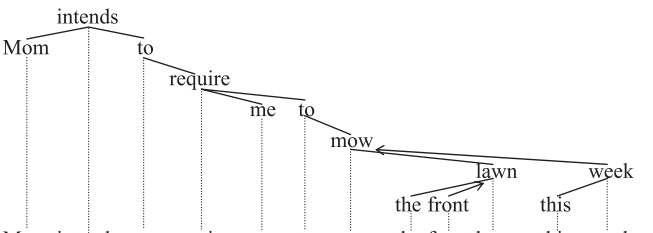


	She	may	take	a	picture	of	me, and
a.	He					of	you.
b.	He			a	picture	of	you
c.	*He				photo.[14]		
d.	*He		have.				
e.	*He		have	a	picture.		

In each of the acceptable (a)- and (b)-clauses, the elided material is a catena. When the elided material fails to qualify as a catena, as in the (c–e)-clauses, the result is bad. Note further that the elided material in each of the acceptable (a)- and (b)-clauses is NOT a constituent.

The elided material in (37a–b, 38a–b) is a string in each case. Gapping can also elide non-strings. When it does so, the elided material is of course a catena:

(39)



	Mom	intends	to	require	me	to	mow	the front	lawn	this	week,	and/but
a.	Dad,									next	week.	
b.	Dad,							the back	lawn.			
c.	Dad				you.							
d.					you					next	week.	
e.					you			the back	lawn.			
f.	*Dad		to	encourage.								
g.	*Dad					to	water.					
h.			*to	encourage		to	water.					

14. The switch here from *picture* to *photo* is purposeful. Gapping requires that a remnant stand in contrast to its parallel in the antecedent clause, e.g.

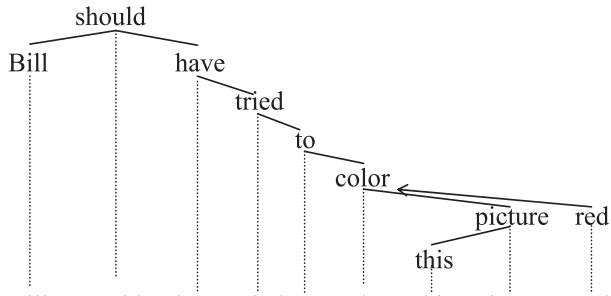
(i) Fred likes Susan, and
a. Sam Sally.
b. *Fred Sally.
c. Bill *Susan.

The switch from *picture* to *photo* is necessary to avoid this confounding factor.

The elided material in each of (39a–e) is a catena. Noteworthy is that the elided material in (39c–e) is a non-string, i.e. it is discontinuous. The elided material can be discontinuous as long as it forms a catena (and obeys the other limitations on gapping). Examples (39f–h) are bad because the elided material does not form a catena.

The data for pseudogapping are similar. The elided material is often not a constituent, but it is always a catena:

(40)

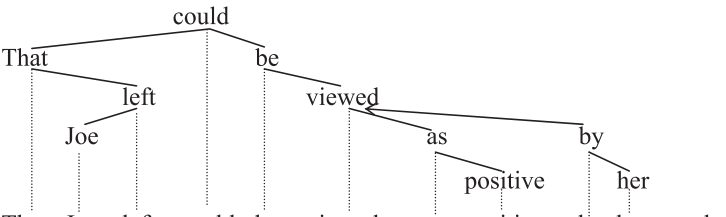


	Bill	would	have	tried	to	color	this	picture	red, and
a.	Fred	would	have						green.
b.	Fred	would	have				that	picture.	
c.	Fred	would	have		to	paint	that	picture	green.
d.	Fred	would	have				that	picture	green.
e.	*Fred	would	have		to	paint.			
f.	*Fred	would	have		to	paint			green.
g.	*Fred	would	have		to	paint		outline	green.

The acceptable (a–d)-clauses each have the elided material as a catena, whereas the elided material in each of the unacceptable (e–g)-clauses fails to qualify as a catena. Note again that the elided material in the acceptable cases is NOT a constituent.

Stripping is a particular manifestation of gapping where only a single remnant appears. The elided material in such cases is always a catena. When the elided material is not a catena, the result is unacceptable:

(41)



`	That	Joe	left	could	be	viewed	as	positive	by	her,	and	
a.	That	Jim	left, too.									
b.	*That	Jim, too.										
c.						*mentioned, too.						
d.							as	negative, too.				
e.									by	him, too.		
f.						*mentioned			by	him, too.		

The acceptable (41a, d, e) have the elided material as a catena. The unacceptable (41b, c, f), in contrast, show the elided material as a non-catena.

Similar data could easily be produced for other ellipsis mechanisms, e.g. VP-ellipsis, sluicing, comparative deletion, etc.[15] This section and the previous two sections have pointed to two major areas where the catena concept provides the basis for a surface structure analysis of the data. The words of idioms are stored as catenae, and the elided material of ellipsis is always a catena. The analyses in terms of catenae must be contrasted with analyses in terms of constituents.[16] It is difficult to see how constituent-based grammars might produce an account as economical as the one offered here in terms of catenae.

5. Syntactic constructions

The discussion of idioms and ellipsis mechanisms has demonstrated that there is ample evidence supporting the existence of catenae and suggesting that they play a major role in syntax and grammar. The next three sections extend the catena concept to constructions that are more syntactic than lexical in nature.

15. In fact we believe that all the data in Culicover and Jackendoff's (2005: Chapters 7 and 8) extensive discussion of ellipsis obey the catena condition.
16. A comment provided by an anonymous reviewer is pertinent here. This comment observes that if the elided material of ellipsis must be a catena, then the remnant(s) must be constituent(s). Indeed, examples (36–41) illustrate that this insight is correct. That is, the remnant(s) that ellipsis leaves behind in each case is/are constituents. This observation is in fact a necessity. In other words, a corollary to the catena requirement on the elided material is that the remnant(s) must be constituent(s).

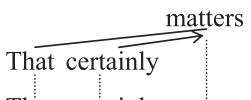
In this regard, these constructions are syntactically fixed but lexically free. Many of the idiomatic expressions examined in Section 4.2 above are, by contrast, lexically fixed but syntactically free. The overarching message throughout the discussion is that constructions are catenae.

5.1. *Major syntactic constructions*

This section considers three constructions of English that appear far to the right on the lexicon-syntax continuum—see (3): the subject-predicate construction, the VP construction, and the subject-auxiliary inversion construction. These three constructions are responsible for much of the core syntax of English. For instance, the subject-predicate construction and the VP construction conspire to make English an SVO language. The point emphasized in this section is that each of these three constructions is merely a two-word catena.

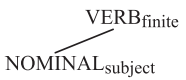
The subject-predicate construction (see e.g. Zwicky 1987: 396; Michaelis and Lambrecht 1996: 218; Kay and Fillmore 1999: 12; Kay 2002: 14–15; Michaelis 2003: 268–269; Tomasello 2006a: 12; Sag 2010) is manifest as a two-word catena:

(42)



a. That certainly matters.
b. That matters.

(43) Subject-predicate construction



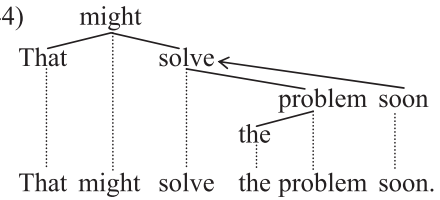
The words of the subject-predicate construct in both (42a) and (42b) are *That* and *matters*. While the modal adverb *certainly* in (42a) adds evidential content to the sentence, it has no impact on the subject-predicate construct. Observe that *That* and *matters* together cannot be construed as a constituent due to *certainly* intervening. They do, however, of course form a catena. The catena in (43) is a schematic representation of the subject-predicate construction. The primary syntactic trait of this construction is that it is a catena consisting of two words, i.e. a finite verb and a subject nominal, whereby the latter must precede the former.

Example (42) illustrates an aspect of constructions that has not gone unnoticed. Müller (2006, 2010: Chap. 11.11) emphasizes that the phrasal understanding of constructions (associated perhaps most with the seminal work of Goldberg 1995) cannot accommodate the appearance of adjuncts and the freer

word order of languages like German. Since the adjunct in (42) interrupts the words of the construction at hand, the construction cannot be viewed as forming a concrete unit of syntax (in a constituent-based system). Müller therefore argues for a lexical account of constructions, whereby constructions are related to lexical entries for predicates via lexical rules. According to Müller, the lexical account has the advantage over the phrasal account insofar the lexical account does not necessitate that the words of the construction at hand form a recognizable phrase. While we agree with Müller's point concerning the inability of (constituent-based) phrasal accounts to accommodate the appearance of adjuncts and the freer word order of languages like German, the debate concerning the phrasal vs. lexical analysis of constructions is largely irrelevant to the current message. Constituent-based accounts of constructions, regardless if they are phrasal or lexical, are incapable of acknowledging that constructs often take on a concrete shape in the syntax in terms of catenae.

The VP construction (Kay and Fillmore 1999: 8; Michaelis 2003: 268–269; Sag 2010) of English also appears far to the right on the lexicon-syntax continuum. This construction consists of a verb (finite or non-finite) and a complement to the right of that verb.

(44)

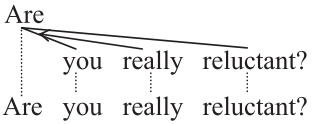


(45) VP construction

Sentence (44) contains two VP constructs, *might solve* and *solve . . . problem*. A liberal understanding of "complement" applies here. Any non-subject dependent that has argument status and/or appears obligatorily is a complement. Thus *solve* is the complement daughter of *might*, and *problem* is the complement daughter of *solve*. As with the subject-predicate construction, the VP construction is a two-word catena. The adverb *soon*, although it appears within the lower VP, is outside of the VP construct. Similarly, the determiner *the* is outside of the VP construct.

The subject-auxiliary inversion construction (Zwicky 1987: 399; Kay and Fillmore 1999: 18; Goldberg 2006: Ch. 8, 2009a: 110; Sag 2010: 46–47) is in a sense the counterpart to the subject-predicate construction:

(46)



(47) Subject-auxiliary inversion construction

The words of the subject-auxiliary inversion construct in (46) are just *are* and *you*. While these two words can in no way be viewed as forming a constituent, they do of course form a catena. An important syntactic trait of this construct is that no sister constituent of the subject can appear between the auxiliary and the subject, e.g. **Are really you reluctant?*.

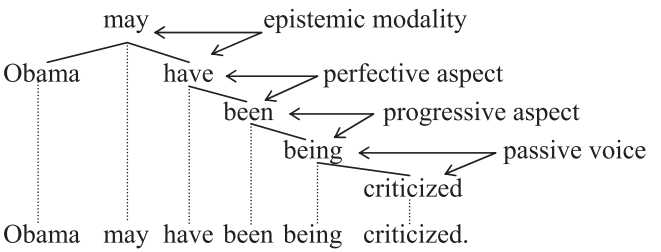
The three constructions just considered occur very frequently. Subject-predicate constructs and the VP constructs appear undoubtedly in a large majority of sentences produced by speakers of English (such as in most of the sentences you are now reading). Subject-auxiliary inversion constructs also appear frequently. In these regards, these three constructions are perhaps most responsible for making English syntax what it is. They contribute greatly to distinguishing the syntax of English from the syntax of, say, Japanese or Russian (or any other language).

5.2. *Periphrastic verb constructions*

Croft (2001: 236, 248–249) and Michaelis (2003, 2004: 282) view periphrastic verb combinations of all sorts as constructions (e.g. modality, perfective aspect, progressive aspect, passive voice, causative, etc.). The catena concept is uniquely capable of assigning periphrastic verb combinations a concrete status in the syntax. As with the other areas considered so far, constituency-based syntax cannot view these constructions as constituents.

Consider the periphrastic verb combinations in the following sentence:

(48)

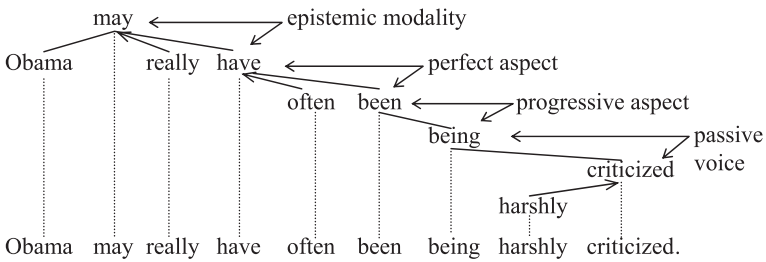


The verbs that express the indicated functional meanings are connected by a dependency in each case, which means they form catenae. It should be apparent

that these catenae cannot be construed as constituents. Note further that we are again dealing with two-word catenae.

In the case of (48), each of the indicated constructs is also a string. But even when these constructs are no longer strings because an adverb intervenes, they are still catenae:

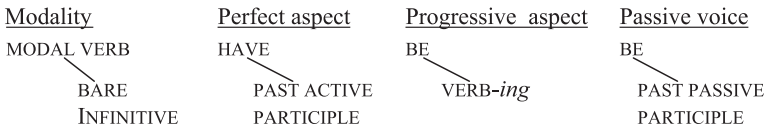
(49)



The catenae expressing potential modality, perfect aspect, and passive voice are no longer strings in (49). Despite this fact, they remain catenae. Note further that these constructs overlap insofar as each of the indicated constructs shares one verb with the construct immediately above it (if there is one) and one verb with the construct immediately below it (if there is one).

Potential modality is expressed by the combination of a modal verb plus a bare infinitive, perfective aspect by the auxiliary HAVE plus a past active participle, progressive aspect by the auxiliary BE plus a present participle; and passive voice by the auxiliary BE plus a passive participle. Constructions of this sort are stored as catenae right of center on the lexicon-syntax continuum. These constructions are represented schematically in the following manner:

(50)



The representations show the primary syntactic traits of these periphrastic verb constructions. The two verbs of each construction form a catena, and the dependent verb of the two follows its head. Note that the representations do not prevent other material (usually an adverb) from splitting the verbs. In other words, these constructions do NOT require that each pair of verbs form a string.

The advantage that this catena-based analysis of periphrastic verb combinations has over constituent-based accounts should be apparent. Constituent-based accounts fail to recognize that each of these constructions enjoys the

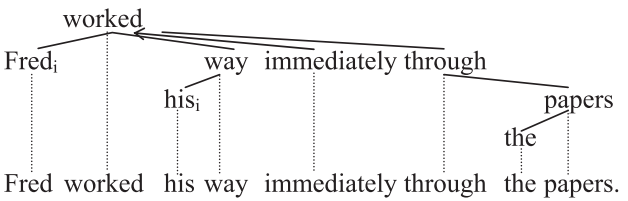
status of a concrete unit of syntax (see for example Michaelis 2003: 296). The discussion returns to periphrastic verb combinations in Section 7.

5.3. *Argument-structure constructions*

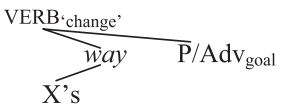
Given catenae, a more precise analysis of argument structure constructions is possible. The specific word combinations that constitute argument-structure constructions can be localized and acknowledged as catenae. A key aspect of CxGs in this area is that multi-word constructions have valence in the same manner that individual predicates do (see e.g. Kay and Fillmore 1999: 19; Michaelis 2004: 8). This fact allows one to view argument structure constructions as augmenting the valence frame of the verb with which they combine.

The *way*-construction (Goldberg 1996; Michaelis 2003: 276) is a prominent example of an argument-structure construction.

(51)



(52) *Way*-construction

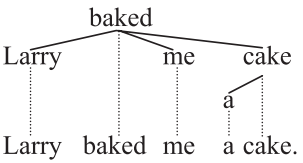


Since the adverb *immediately* splits the words of the *way*-construct here, an analysis is blocked that views the *way*-construct as a constituent. The words of the *way*-construct in (51) do, however, form a catena. The only completely fixed word of the *way*-construction is *way*. The possessor must be co-indexed with the subject and the goal argument is a PP or an adverb. The verb must select an agent subject and be compatible with a semantic frame that has this agent undergoing a literal or metaphorical change of location or state. The verb can be unergative (e.g. *She slept her way to good health, They worked their way to fame*) or ambitransitive (e.g. *Fred ate his way through the birthday cake*, *Susan performed her way to their admiration*), but not unaccusative (e.g. **The vase broke its way into innumerable pieces*, **The chair shifted its way to the right*). If the verb is a simple transitive verb, the result can be marginally acceptable at times (e.g. *?Sam washed his way out of debt at the carwash*, *?Fred built his way to prosperity*). In such cases, the construction forces the

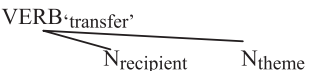
verb—since it cannot have two objects—to take an intransitive, change of state reading.[17]

The ditransitive construction is another argument structure that has received much attention in the literature (e.g. Goldberg 1995, Bergen and Chang 2005, Holmes and Hudson 2005).

(53)



(54) Ditransitive construction



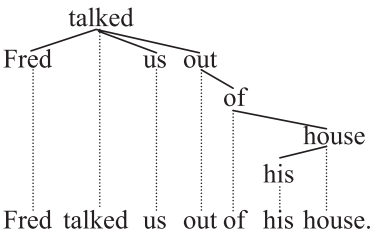
Both the recipient and the theme must be nominal expressions. The verb must be compatible with a semantic frame that expresses literal or metaphorical transfer of a theme object to a recipient, which means it should be transitive.[18] If it is unergative or unaccusative, the result is bad (e.g. **Susan laughed me ridicule*, **Fred slept you laziness*, **The loaf of bread broke him a slice*), and if the verb is transitive but cannot express literal or metaphorical transfer of a theme object to a recipient, the result is also bad (e.g. **The bottle contains me water*, **We saw them an opportunity*). An interesting aspect of ditransitive constructs is that nothing can intervene between the verb and the first object (e.g. **Larry baked twice me a cake*). Heavy constituent shift can, however, have an adverb splitting the objects (e.g. *Larry baked me twice a really unusual and delicious cake*). In such cases, the words of the construct still form a catena.

17. The *way*-construction occurs very often with the transitive verb *make*, e.g. *We made our way to the store*. The occurrence of *make* with *way* is so frequent that the expression can be seen as the prototypical *way*-construction. As the prototype, the *make-way*-construction enjoys idiom status and therefore does not challenge the observation that the *way*-construction prefers to combine with intransitive or ambitransitive verbs

18. An anonymous reviewer has pointed out that the intransitive verb *dream* can appear in a ditransitive construct, e.g. *Susan dreamed her husband a good job*. Apparently, *dream* is compatible with a semantic frame that expresses literal transfer of a theme object to a recipient. We assume in this regard that most intransitive verbs are incompatible with such a semantic frame.

The third and final argument structure construction considered here is the caused-motion construction (Goldberg 1995: Ch. 7; Michaelis 2003: 275; Bergen and Chang 2005).

(55)



(56) Caused-motion construction

The object argument must be an affected nominal and the goal a PP or an adverb. The theme argument must literally or figuratively undergo movement or change of state. The verb is relatively unrestricted: it can be unergative (*Pam cried us to shame*, *Spot barked the cat up a tree*), accusative (*They ate us out of house and home*, *Bill put salt in his soup*, *The ball knocked him off his feet*), or ergative (*You opened the window into the garden*, *They flew the plane over the mountains*), but not unaccusative (**The top spun the child to fascination*, **The music played them into a festive mood*, **The picture hung it out of reach*). As with the previous two constructions, an adverb can split the words of this construct; in such cases, the words of the construct still form a catena.

This section has briefly considered three prominent argument structure constructions of English. As with all other constructions, the structures of these constructions are stored as catenae in the lexicon. Argument structure constructions often augment the valence frame of the verb with which they appear.

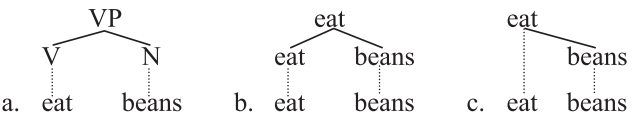
6. Formalizing constructions

A difficulty facing constituency-based CxGs has been mentioned above a number of times. This difficulty is that if the syntax has only constituents to work with, then one must assume that many constructions are stored as fragments, i.e. they are incomplete constituents because they contain free subconstituents. The difficulty is seen in the manner that constructions are formalized, i.e. with the box diagrams and AVMs (Michaelis and Lambrecht 1996: 225;

Kay and Fillmore 1999: 20; Croft 2001: 212; Kay 2002; Michaelis 2003: 294, 2010; Sag 2010). The box diagrams and AVMs are often incomplete in the sense that they represent just a tree fragment as opposed to a full constituent. In this regard, this section demonstrates that if the box diagrams and AVMs are recast in a manner consistent with dependency-based syntax, the result is much simpler. We are echoing a point expressed by Holmes and Hudson (2005) in this respect: if CxGs adopt dependency-based structures, much of the formal apparatus disappears. The Subset Principle (Kay and Fillmore 1999: 9), the Maximality principles (Kay and Fillmore 1999: 19), and the Head-Feature Principle (Sag 2010: 111), for instance, vanish, since dependency structures do not and cannot distinguish a head daughter from non-head daughters.

Before examining the box diagrams and AVMs directly, the change to be conducted on the schematic representations is illustrated here first with VP subtrees.

(57)



Tree (57a) shows a traditional VP. Tree (57b) is an alternative expression of (57a) that is consistent with Chomsky's bare phrase structure (BPS), the words themselves standing in for their projections. The move from the constituency tree (57b) to the dependency tree (57c) is not a big one. The reduction consists of compacting the mother and its head daughter into a single node, which appears then in the position of the mother. Constituency box diagrams and AVMs that represent constructions will now be altered in an analogous manner. The part of the schema that represents the head daughter is eliminated, so that only the mother and any non-head daughters remain.[19]

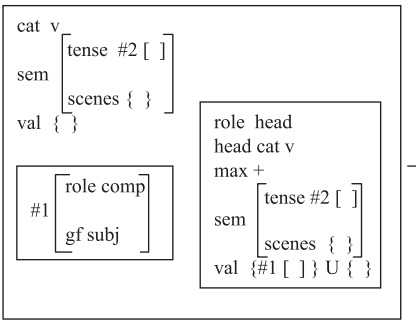
19. Box diagrams are traditionally assumed to represent constituency structure, not dependency structure. Box diagrams are, however, merely a notational convention that can be interpreted either way. The same is true of brackets; they are traditionally employed to represent constituency structure, not dependency structure. Brackets too, however, are fully capable of representing dependency structure, e.g.

    (i) [Bill [wants [to [eat something]]]]. – Brackets show constituency structure
    (ii) [Bill] wants [to [eat [something]]]. – Brackets show dependency structure

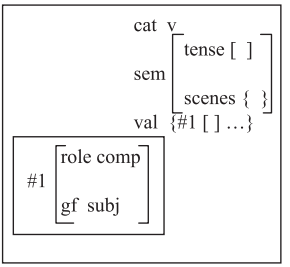
    The dependency structure identifies heads, dependents, and sisters by enclosing dependents within more brackets than heads.

Kay (2002: 14) formalizes the subject-predicate construction with the box diagram (58a), which we have adapted slightly:

(58) a.



b.

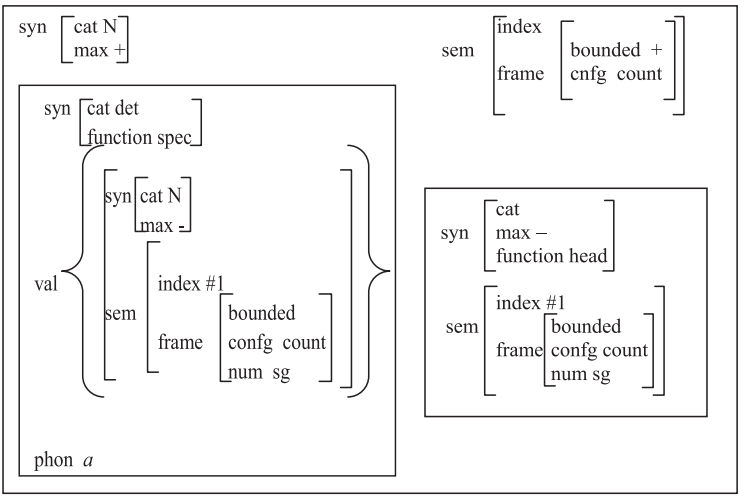


The box diagram (58b) is the DG translation of the constituency box diagram (58a). The dependency-based diagram contains the same information as the constituency-based diagram. The main difference between the two is that the redundancies that appear in the constituency grammar diagram have been removed. These redundancies are due to the repetition of information across head daughter and mother. Furthermore, the constituency grammar diagram cannot be construed as representing a constituent, whereas the DG diagram represents a concrete unit of syntax, namely a catena.

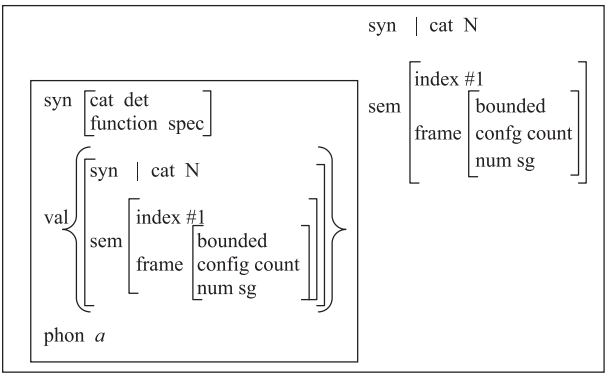
A secondary difference between (58a) and (58b) is the manner in which valency information is encoded. Constituency-based formalizations often see the valents of a predicate being satiated one at a time as information is passed up the hierarchy from head daughter to mother. This incremental reduction of the valency list is not possible (nor is it desirable) given dependency-based architecture. The valents of a mother are matched by that mother's daughters. This situation is reflected in (58b) in the linking of the subject object identified with the tag #1. The details of the dependency-based formalization in this area are not explored here and in this regard, aspects of the dependency-based formalization remain to be worked out.

Michaelis (2003) formalizes the indefinite determination construction (e.g. *a book*) with (59a):

(59) a.



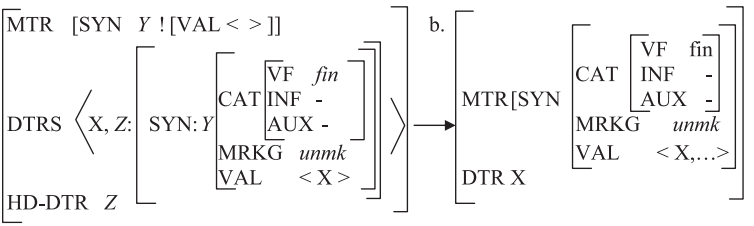
b.



The details are again not important. What is important is the manner in which the same information appears in both (59a) and (59b). The constituency diagram (59a) is again redundant, much of the same information being repeated across head daughter and mother. By removing the head daughter, a significant reduction is accomplished without incurring a loss of information. Furthermore, Michaelis' constituency-based box diagram (59a) cannot be understood as representing a constituent, as seen in an NP like *a good book*, where *a* and *book* no longer form a constituent due to the intervention of *good*. The dependency-based box diagram (59b), in contrast, represents a catena, a concrete and well-defined unit of syntax.

One final illustration solidifies the message. While Sign-Based CxG (Sag 2010) uses attribute value matrices (AVMs) instead of box diagrams, it is still

a constituency-based system and must therefore view constructions as non-constituents, with the same redundancy of information occurring across head daughter and mother. The AVMs used to represent constructions can be simplified greatly in a manner similar to the manner used to simplify the box diagrams above. Sag (2010: 111) represents the subject-predicate construction with (60a):

(60) a.


b.

The same greatly reduced representation obtains with this example. The AVM (60b) is what remains after the redundancies arising from the repetition of information across mother and head daughter have been removed. The need to distinguish a head daughter from the non-head daughters disappears. And as with the previous examples, the constituency-based AVM represents a non-constituent, whereas the dependency-based AVM shows a catena.

This section has demonstrated that dependency-based constructions can be formalized using the same conventions used to formalize constituency-based constructions. The resulting dependency-based diagrams are, however, minimal compared to their constituency-based counterparts. Since the more economical dependency-based schemata contain the same basic information as the constituency-based schemata, they should be preferred.

7. Intersecting constructs

This section addresses constructs that are broken up by syntactic processes. The discussion begins by considering what Claim 1 says about constructs:

Claim 1
Constructions are catenae.

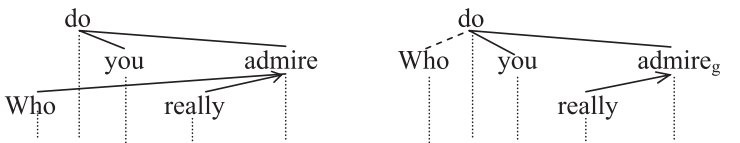
This claim says nothing about the actual manifestations of constructions, i.e. nothing about constructs. The difficulty in this area is that the words of lexically fixed constructs often fail to form catenae in actual syntax. This occurs in a number of different ways, for instance with auxiliary verbs of modality, aspect, and voice, with relative clauses, and above all, with long distance dependencies of every sort. This section examines such cases, i.e. cases where the words of lexically fixed constructs fail to form catenae in actual syntax.

The means by which the data are then addressed is to acknowledge that lexically fixed constructs can be broken up only by virtue of their overlapping and intersecting with other, lexically less fixed constructs.

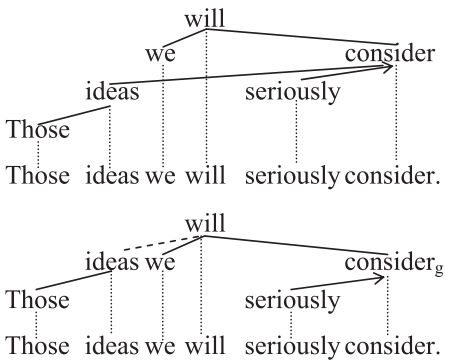
But before proceeding to these points, we need to acknowledge that if the DG at hand posits networks in surface syntax as opposed to just trees, as Word Grammar does (Hudson 2007), then Claim 1 may suffice on its own (i.e. Claim 2 is unnecessary). Or if the DG at hand is multistratal and thus acknowledges deep dependencies, as Meaning Text Theory does (Mel'čuk 1988, 2003), then Claim 1 also may suffice on its own because the relevant words of a given construct might qualify as a catena below the surface. While we can acknowledge that there may be potential in these areas, we think that Claim 2 is necessary. For us networks on the surface are implausible for a couple of reasons. Above all, the number of catena in a given structure increases dramatically. The overly large number of catena reduces the value of the catena concept in general because the number catena increases to the point where the catena concept is robbed of its predictive potential, too many word combinations qualifying as catenae. And we reject multistratal systems because in our view, the existence of deep strata cannot be verified empirically. Given our stance in these areas, Claim 2 is necessary.

An understanding of the current DG analysis of discontinuities must now be established. The current system addresses discontinuities in terms of *rising* (Groß and Osborne 2009: 51–56). Rising is illustrated across the following (a)- and (b)-trees. An example from German is used to illustrate scrambling:

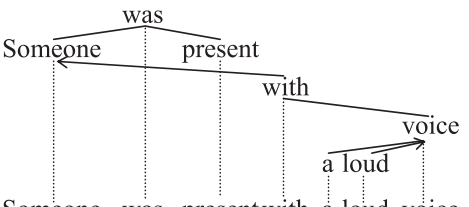
(61)



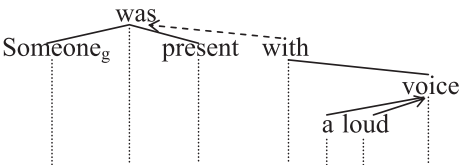
(62)



(63)

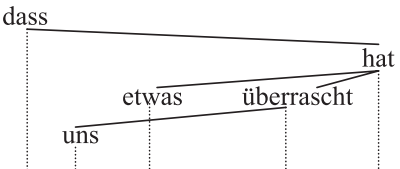


a. Someone was present with a loud voice.

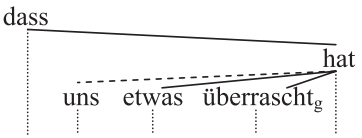


b. Someone was present with a loud voice.

(64)



a. dass uns etwas überrascht hat
that us something surprised has
'that something surprised us'



b. dass uns etwas überrascht hat

The crossing lines (= projectivity violations) in the (a)-structures illustrate discontinuities. A dependent is separated from its governor by one or more words that its governor does not dominate. The (b)-structures illustrate the means by which some DGs address such discontinuities (e.g. Bröker 2003: 294; Eroms and Heringer 2003: 26; Starosta 2003). The relevant catena takes on a word as its head that is not its governor as in the (b)-trees. In all such cases, rising has occurred.[20] The dashed dependency edge marks a dependent the governor of

20. Rising should not be understood in terms of movement. Our system is decidedly representational, as emphasized in Section 2. The term "rising" is used in a metaphorical sense. It simply denotes a constellation where a catena dominates its governor or has attached to a word that dominates its governor.

which is not its head, and the g-subscripts mark the governor of the risen catena (= the one word that licenses the appearance of that catena).

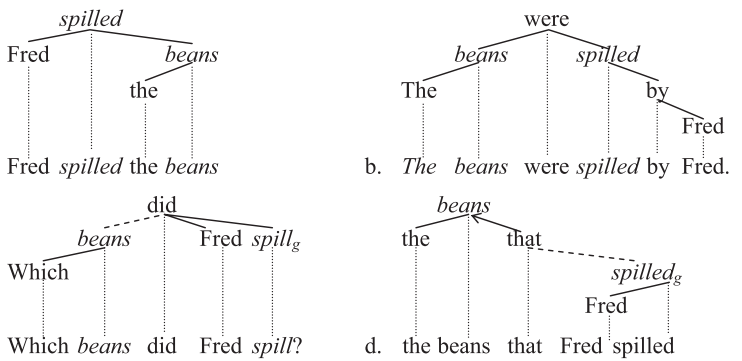
The primary characteristic of rising is formalized in terms of the Rising Principle:

Rising Principle
The risen catena itself or its head must dominate its governor.

Examining each of the (b)-structures, one sees that the Rising Principle is obeyed in each case. In the instance of *wh*-fronting in (61b), *do*, the head of the risen catena *who*, dominates *admire*, the governor of the risen catena *who*. In the instance of topicalization in (62b), *will*, the head of the risen catena *those ideas*, dominates *consider*, the governor of the risen catena *those ideas*. In the instance of extraposition in (63b), *was*, the head of the risen catena *with a loud voice*, dominates *someone*, the governor of the risen catena *with a loud voice*. And in the instance of scrambling in (64b), *hat*, the head of the risen catena *uns*, dominates *überrascht*, the governor of the risen catena *uns*.

In order to show how constructs can be broken up in the syntax, the discussion returns to idioms. As mentioned in Section 2, some idioms are both lexically and syntactically completely fixed (e.g. *Bill kicked the bucket*, **The bucket was kicked by Bill*), whereas many other idioms are lexically fixed but syntactically free to a greater or lesser extent (e.g. *Fred spilled the beans*, *The beans were spilled by Fred*). The latter idiom type is what interests us here. The words of these idioms can be broken up by various syntactic processes:

(65)



The idiomatic readings are retained in (65b–d) despite the fact that the lexically fixed words of the idiom no longer form catenae. Notice that examples (65c)

and (65d) involve rising, as the dashed dependency edges and g-subscripts indicate. *Which beans* has risen in (65c), and *that* has risen in (65d).[21]

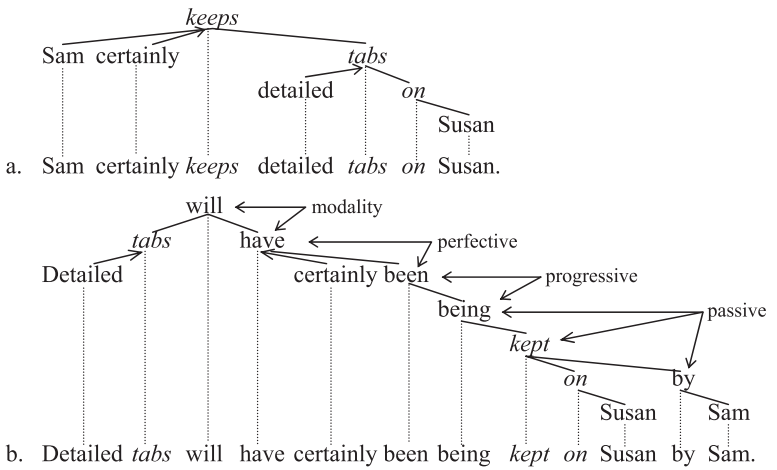
The fact that the words of idioms can fail to form catenae as in (65b–d) appears to destroy the value of the catena concept. An additional observation restores the worth of the concept, however. This observation is that when the lexically fixed words of idioms are broken up, their distribution still follows fixed and predictable patterns. These patterns reflect the presence of other, lexically less fixed constructs. The insight is expressed concretely as Claim 2:

Claim 2
A lexically fixed construct can be broken up by virtue of its co-occurrence with (a) lexically less fixed construct(s). The words of the more fixed construct always form a catena together with the words of the less fixed construct(s).

When lexically fixed constructs are indeed broken up, they necessarily overlap with or are interrupted by one or more, more syntactic constructs. That constructs often overlap and intersect is widely acknowledged (e.g. Lakoff 1987: 533; Zwicky 1987: 396; Goldberg 1995: 50, 1996: 40; Michaelis and Lambrecht 1996: 216; Kay and Fillmore 1999: 12; Michaelis 2003: 265; Goldberg 2009: 95).

Claim 2 is illustrated using a couple of examples. The first example involves periphrastic verb combinations of the sort discussed in Section 5.2. When the words of an idiom are interrupted by a periphrastic verb combination, the idiom construct and periphrastic verb construct(s) together form a single catena:

(66)

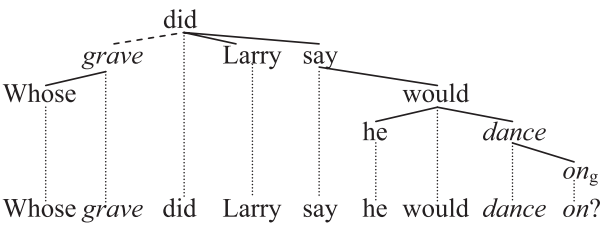


21. The risen catena in (65d) is the relative pronoun *that*. This catena has undergone *type 2 rising*. Type 2 rising is distinguished from *type 1 rising* in terms of the position of the risen

Tree (66a) shows that the words of the idiom *keep tabs on* form a catena in a simple declarative sentence. Sentence (66b) demonstrates that these words are broken up when they co-occur with a passive construct. In addition, the auxiliary verbs of the modal future construct, the perfective aspect construct, and the progressive aspect construct further separate *tabs* from the other words of the idiom. Example (66b) hence illustrates that the words of the idiom are broken up by the lexically less fixed periphrastic verb constructs and that all four constructs together form a single meta catena: *tabs will have . . . been being kept on . . . by*. This catena excludes the four words that are not part of any of these five constructs, i.e. *detailed*, *certainly*, *Susan*, and *Sam*.

Discontinuities of the sort illustrated in (61–64) are construct types that also require an account in terms of Claim 2. A long distance dependency can break up the words of lexically fixed constructs. This point is illustrated here with (67):

(67)



The fixed words of the idiom *dance on X's grave* are broken up by *wh*-extraction. Following Culicover and Jackendoff (1999: 560) and Kay and Fillmore (1999: 14), we posit a left-isolation construction to address *wh*-extraction. The left-isolation construction is, however, just one type of discontinuity among many (e.g. topicalization, scrambling, extraposition), as examples (61–64) suggest. All these discontinuity types can be addressed in terms of catenae. One acknowledges that there is always a catena that extends from the root of the risen catena (here *grave*) to the governor of the risen catena (here *on*). This catena is itself a construct, namely a *discontinuity construct*. The discontinuity construct in this case is thus the catena *grave did . . . say . . . would dance on*. This catena contains all the words of the idiom construct and all the words of the discontinuity construct in line with Claim 2.

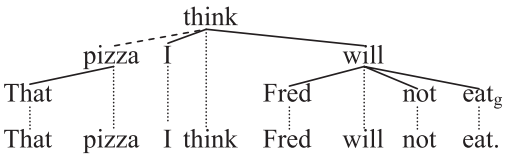
The following examples, which do not involve idioms, illustrate further the manner in which discontinuities in general can be addressed in terms of

---

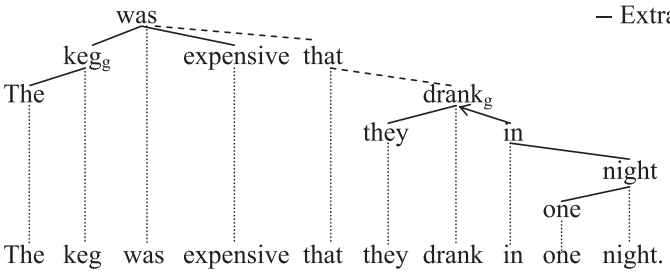
catena. The risen catena of type 2 rising has the risen catena itself dominating its governor, whereas type 1 rising has the head of the risen catena dominating the governor. This distinction is discussed in more detail in Groß and Osborne (2009) and Osborne et al. (2013).

discontinuity constructs. An example from German is again used to illustrate scrambling:

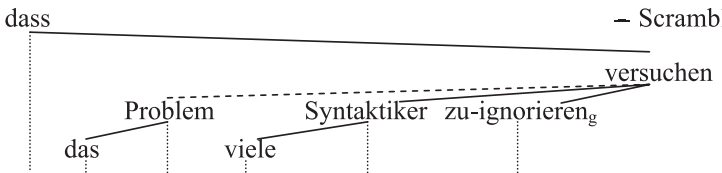
(68) – Topicalization



(69) – Extraposition



(70) – Scrambling



'that many syntacticians try to ignore the problem'

In each case one can trace along the chain of words and edges from the root of the dislocated catena to the governor of that catena. The words through which one traces constitute the discontinuity construct. In (68), the discontinuity construct is *pizza . . . think . . . will . . . eat*; in (69) the upper discontinuity construct is *keg was . . . that* and the lower discontinuity construct is *that . . . drank*; and in (70) the discontinuity construct is *Problem . . . zu-ignorieren versuchen*. By examining the nature of these catenae, one can ascertain the traits of each discontinuity type, and the discontinuities themselves are viewed as constructs.

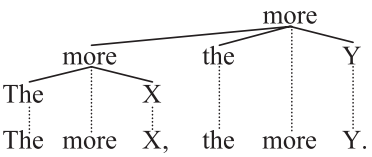
These few remarks about idioms and discontinuity constructs should suffice to give an impression of the analysis in terms of catenae. The words of certain lexically-fixed contructs can be broken up if they overlap and intersect with lexically less fixed constructs, and discontinuities can be addressed concretely in terms of catenae, whereby discontinuity constructs are catenae. Groß and Osborne (2009) provide a much more in depth analysis of discontinuities in the current DG framework.

8. The more X the more Y

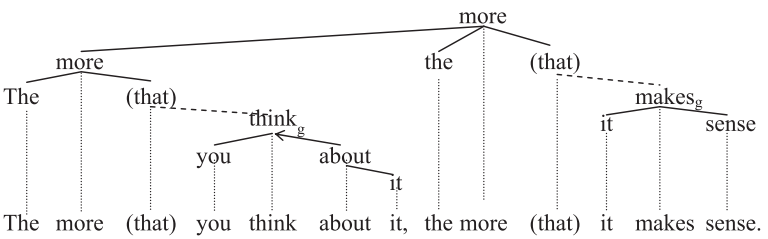
The concepts of catena-based DG introduced and illustrated above are now directed at a particularly recalcitrant construction: the *the more X the more Y* construction—see example (2). This construction has been discussed extensively in the literature (McCawley 1988; Culicover and Jackendoff 1999; Borsley 2004), but in our opinion, these accounts are unconvincing in part due to the excessive complexity of the constituency-based frameworks in which they are couched. Needless to say, our catena-based DG analysis of this construction is quite unlike these previous accounts. The key aspect of our analysis is of course that the fixed parts *the*, *more*, *the*, and *more* form a catena and this catena is stored as such on the lexicon-syntax continuum.

Three illustrative tree structures are produced here first for orientation. The first is a reproduction of (2) from the introduction:

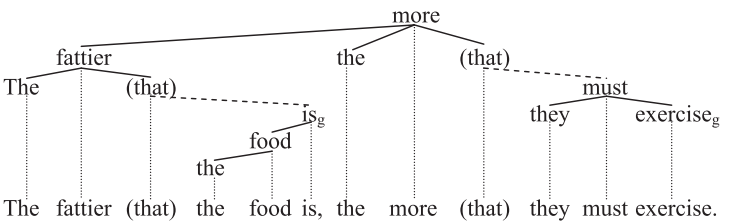
(71)



(72)



(73)



The fixed elements of the construction form a catena, i.e. *the*, *more*|*fattier*, *the*, and *more* form a catena in each case, just as Claim 1 predicts. The X and Y in (71) mark the arguments of the construction, whereby these arguments often appear as complete clauses. Note as well that the affix *-er* can appear instead of *more*, depending on the properties being compared. When this occurs, the word containing this affix forms a catena with the other elements of the con-

struction. Beyond these key points, there are a number of questions about this analysis. Some of these questions are listed here:

1. How can we know that the second *more* dominates the first *more* (and not vice versa)?
2. What is the status of the X and Y argument clauses, i.e. the clauses the root of which is *that*?
3. What is the category status of the *more*s?
4. How does this analysis accommodate cases where a phrase immediately follows *more*, e.g. *The more free food, the more people*.
5. How does this analysis address the frequent occurrence of ellipsis that occurs with the construction, e.g. *The older ~~they are~~, the wiser ~~they are~~*?

The discussion in the following paragraphs answers each of these questions in turn. But first, one must acknowledge that the *the more X the more Y* construction is just that, namely a construction, and as such, it behaves in a manner that is to an extent NOT predictable from the behavior that one associates with its parts.

A number of observations produced by Culicover and Jackendoff (1999) indicate that the second *more*-expression dominates the first (not vice versa). Some of these observations are given here with illustrative data:

(74) It is imperative that
  a. the more Fred eats, the more he exercise.
  b. *the more Fred eat, the more he exercises.
(75) The more he laughs, the more people avoid him,
  a. don't they?
  b. *doesn't he?
(76) a. The more Bill_i tries, the more he_i succeeds.
  b. The more he_i tries, the more Bill_i succeeds.
  c. If Bill_i tries, he_i succeeds.
  d. If he_i tries, Bill_i succeeds.
  e. Bill_i succeeds, if he_i tries.
  f. *He_i succeeds if Bill_i tries.

Examples (74a–b) show that if the subjunctive of an imperative expression is used, it appears on the verb in the second *more* expression, not on the verb in the first. Examples (75a–b) demonstrate that if a tag question appears, it is built on the subject in the second *more*-expression, not on the subject in the first. And examples (76a–f) illustrate that binding data identify the second *more* expression as being superordinate to the first. Taken together, these observations strongly support the basic hierarchy assumed, whereby the second *more* dominates the first.

The second matter to address concerns the status of the X and Y arguments. What is the syntactic status of these expressions? The optional appearance of *that* indicated in (72–73) answers this question. These expressions are relative clauses. If the relative proform is absent, then a reduced relative clause is present. We know that *that* in such cases has the status of a relative pronoun (and not of pure subordinator *that*) because the clear relative pronouns *who* and/or *which* are also possible (context allowing), e.g.

(77) The more people who you invite, the more people who will come.
(78) ?The more things which were tried, the more things which succeeded.

Stylistically we prefer *that* in (78), but we think that *which* is marginally possible. The most important observation in this area is that if the relative pronoun is the subject of the relative clause, its appearance is obligatory, e.g.

(79) a. The more who try, the more who succeed.
b. *The more try, the more succeed.

This behavior is consistent with that of (reduced) relative clauses. Given these observations, the conclusion that the X and Y arguments are relative clauses is motivated.

The next aspect of the construction to be examined concerns the category status of the *more*s. Are these *more*s nouns, adjectives, or adverbs? The first observation that bears on this question is that the construction is easily built on underlying adjectives (e.g. *The bigger, the better*) and on adverbs (e.g. *The slower he speaks, the sooner I understand*). Despite this observation, there are good reasons to assume the *more*s consistently have noun status. The first observation that supports this conclusion is the obligatory appearance of the definite articles *the* . . . *the*. The definite article introduces a noun, not an adjective or adverb. The second observation that supports the conclusion is that the relative pronoun *that* can always appear and is preferred over *which*. Note in this regard that when a relative clause is built on an adjective, *which* must appear, e.g.

(80) a. *He is loud that she isn't.
b. He is loud, which she isn't.

which can hardly appear when the underlying expression is an adjective:

(81) a. The louder that he is, . . .
b. ??The louder, which he is, . . .

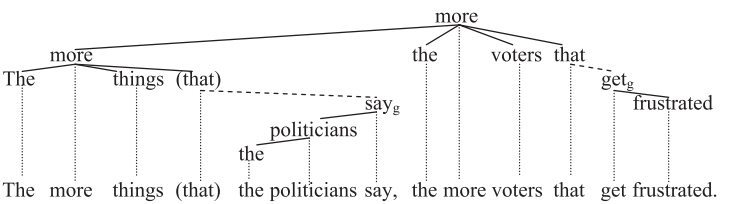
A third observation that supports the conclusion is seen when *the* . . . *-er* tries to modify a noun, e.g.

(82) a. *The louder customer that he is, the more that people avoid him.
b. *The older politicians that they are, the better decisions that they make.

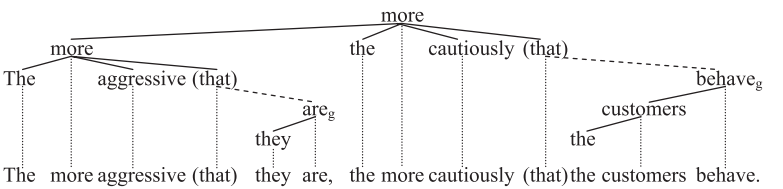
Sentences (82a–b) are bad because *louder* and *older* have noun status (not adjective status) and therefore cannot modify the nouns *customer* and *politicians*. Taken together, these observations strongly support the conclusion that the *more*/*-er*s have noun status.

The fact that the *more* expressions have noun status generates a further question concerning the cases that have a "true" noun immediately following *more*. What is the hierarchical status of such a noun? We assume that the noun is an apposition-like modifier of *more*, which means it is dependent on *more*, e.g.

(83)



(84)

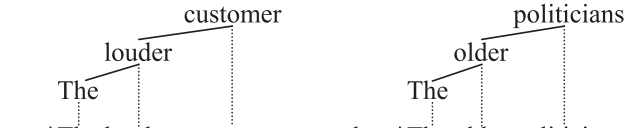


The hierarchical status of the nouns *things* and *voters* in (83) and of the adjective *aggressive* and the adverb *cautiously* in (84) is the focus. These words appear as daughters of the *more*s. The nouns *things* and *voters* are therefore apposition-like modifiers, and the adjective *aggressive* and adverb *cautiously* are post-modifiers (as opposed to pre-modifiers) of the nominal *more*s. One observation that supports this analysis is that the nouns can often be elided, e.g. *The more ~~people~~ that come, the more ~~money~~ that we earn*. Frequent ellipsis in such cases suggests that the relative clause must be attaching to *more*, not to the noun. In order for the relative clause to attach to *more*, the position of the noun must be such that a direct dependency between *more* and the relative clause can obtain. Positioning the noun as a dependent of *more* makes room for this dependency.

A second observation that supports the analyses in (83–84) is seen in examples like (82a–b). The only other analysis that might make sense in cases like (83–84) is the one where *more* appears as a daughter of the noun/adjective/

adverb (as opposed to as the mother of the noun/adjective/adverb). Such an analysis incorrectly predicts cases like (82a–b) to be acceptable.

(82′)



a. *The louder customer... b. *The older politicians…

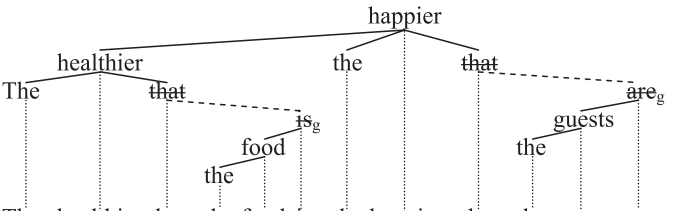
If the expressions *louder* and *older* were daughters of the nouns *customer* and *politicians* as shown here, we would expect (82a–b) to be acceptable. Based on these data, we can conclude that when a noun, adjective, or adverb immediately follows *the more*, this noun, adjective, or adverb is a post-daughter of *more*.

The final aspect of the *the more X the more Y* construction mentioned here concerns the frequent ellipsis that the construction allows. We assume that the ellipsis mechanism involved is the same ellipsis mechanism that frequently reduces relative clauses down to a predicate expression (often a passive participle):

(85) a. The people ~~who were~~ interviewed for the position . . .
b. A question ~~that was~~ asked twice . . .
c. The house ~~that was~~ painted by the boys . . .

This ellipsis mechanism is the same mechanism that reduces the relative clauses of *the more X the more Y* constructs, e.g.

(86)

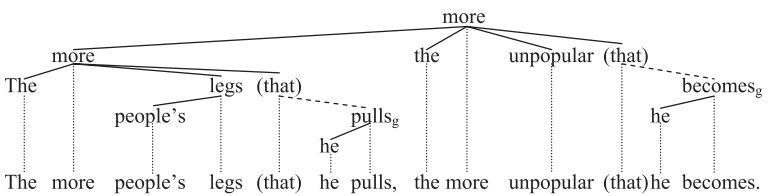


a. The healthier ~~that~~ the food ~~is~~, the happier ~~that~~ the guests ~~are~~.
b. The more ~~there are~~, the merrier ~~it is~~.
c. The more ambitious ~~that~~ the students ~~are~~, the more material we can cover.

This ellipsis mechanism has the ability to elide a subject or predicate pronoun and the copula. The discussion here shall not explore the nature of this mechanism, but rather it merely points to the fact that the elided material (marked by the strikeouts) qualifies as a catena in each case, and the analysis is therefore consistent with the point made in Section 4.4, where it was demonstrated that the elided material of ellipsis always corresponds to a catena.

Before concluding the discussion, one last example is examined. An anonymous reviewer questions whether the following example might contradict Claim 2:

(87)



Ignoring the structure that we assign to this sentence for the moment, the reviewer suggests that this example should constitute a problem for Claim 2. The difficulty occurs with the combination of two lexically fixed constructs: the *the more X the more Y* construct and the *pull X's leg* construct. Again ignoring the structure that we assume, these constructs appear to overlap in such a manner that has the *pull X's leg* construct interrupting the *the more X the more Y* construct (or perhaps vice versa), a situation that would be problematic for Claim 2, since it is difficult to say that one of these constructs is more or less syntactic than the other.

The difficulty that the reviewer sees does not arise, however, as the structure of (87) shows. The *the more X the more Y* catena is actually NOT interrupted by the *pull X's leg* catena. If there is a difficulty at all with the analysis, it occurs with the nature of the relative pronoun *that*. Apparently this pronoun can take *people's legs* as (part of) its antecedent, and in so doing, it "contains" the *X's leg* part of the idiom. Since *(that) pulls* is a catena, there is no difficulty for Claim 2 (or Claim 1). Note in this regard that the freer type of idiom allows proforms, e.g. *You keep tabs on Susan, and I keep them on her, too*. Given the analysis and these observations, example (87) is NOT a problem for the current catena-based system.

To conclude this section, we acknowledge that there are a number of important aspects about the *the more X the more Y* construction that have not been examined here. We think, however, that the discussion has demonstrated that despite the apparent difficulties associated with the construction, the current system is capable of producing a plausible account that is consistent with Claims 1 and 2.

9. Catenae in cognition

The previous sections have argued that the catena is a very useful tool in the analysis of sentence structure. Consequently, the necessity arises to address the catena's psycholinguistic or cognitive status. Since the catena is a very recent

addition to the canon of grammatical units of form, direct empirical evidence on this matter is not yet available. Experimental linguists can only test those notions that have been proposed in open debate. The current proposal should thus be seen as a hypothesis awaiting testing, which we hope it will receive in due time by experts in the field.

Drawing on previous research in psycholinguistics to validate the status of the catena is not entirely impossible, though. Some attention has been devoted to empirical arguments for dependency relationships (Hudson 2003; Leiss 2003). Even though catenae are more than dependency relationships, any empirical evidence for dependency relationships must necessarily count as evidence for catenae. Logically speaking, dependencies are relationships, while catenae are sets (of words). A dependency is a directed and asymmetric relationship that identifies one word as the mother and another as the daughter. A catena, on the other hand, identifies the words entertaining dependency relationships as a specific set. Since dependency relationships cannot be directly observed, they must be inferred from the behavior of the words assumed to entertain dependency relationships. In order to identify dependency relationships, one must observe the behavior of individual words (omissibility), their behavior as part of a word combination of words (co-occurrence), and the behavior of that entire word combination (distribution) (Mel'čuk 2003: 205). Catenae, on the contrary, can be directly observed, since a catena is the concrete unit of form that the words connected by dependency relationships take on. Hence, any evidence for dependency relationships is necessarily evidence for catenae because catenae are the basis of observation, i.e. they are the objects that need to be observed in order to arrive at the legitimate conclusion that dependency relationships obtain between words.

Sections 4.2 and 4.3 demonstrated that idiom formation can be parsimoniously accommodated by acknowledging catenae. The analysis of idioms as non-constituent units of form was emphasized by O'Grady (1998). The salient point of O'Grady's argument is that idioms such as, e.g. *have X's hide*, cannot qualify as a constituent if they want to exclude the free material (here: the possessor marked by X) from the idiom. O'Grady's seminal contribution is that meaningful units do not need to take on constituent form, but rather obtain in the form of catenae (= O'Grady's "chains"). This assumption allows for a parsimonious account of processing and storage, and hence is the more desirable option for any theory of grammar that aspires to make statements on language cognition.

Section 4.4 addressed ellipsis, a label for a plethora of distinct phenomena that have in common that material is missing from the surface. Constituency-based grammars face great difficulties in accommodating ellipsis data, not to speak of formulating an overarching theory of ellipsis. Since Ross' (1967) seminal contribution, a vast literature has accumulated that tries to explain

ellipsis in terms evacuation (i.e. movement) out of a constituent followed by deletion. The analyses in Section 4.4, however, demonstrate that ellipsis concerns catenae: the elided material must qualify as a catena. The benefit of this account should be evident: neither domain-specific modules, nor movement needs to be stipulated, but rather the ellipsis data can be explained on the surface. The consequence for a cognitive enterprise should be evident as well: if ellipsis is the elision of catenae, then it is not implausible to assume that catenae figure in linguistic cognition.

Another topic that has received an extraordinary amount of attention in the literature is displacement. Section 7 demonstrated that displacement phenomena need not invoke distinct grammatical modules (semantic vs. syntactic structure, deep vs. surface structure, etc.) or movement. Postulating such modules and mechanisms increases the burden on the cognitive language ability. We think, in contrast, that displacement is a surface structural constellation with the following characteristics: 1. a word or combination of words (= the risen catena) is displaced if it cannot be construed as forming a constituent with its governor. 2. The risen catena and its governor are connected by a catena (= displacement construct). Again, the catena, rather than the constituent, is implicated in the workings of a central and important linguistic phenomenon. Indeed, the proposition that displacement is entirely a constellational property of surface structure is far-reaching, and may well elicit incredulity. But again, if true, the benefits of this approach are great. Theories of grammar are now in a position to relieve themselves of notions that unduly constrain and burden the cognitive abilities implied in language comprehension and production.

The cost of accepting the catena, on the other hand, is minimal: one merely needs to turn attention to surface data. That *per se* is ultimately necessary because it is the surface that contributes the data for language acquisition. If surface data can be parsimoniously analyzed and described without positing hidden levels of representation, i.e. unobservable strata and mechanisms, then the implication for the cognitive enterprise is evident: rather than having the complex structures that many constituency-based theories posit, language is structured in a much more transparent fashion. This transparency of structure can facilitate the efforts to explain language acquisition. After all, language is ultimately transmitted via the bottleneck of babies' mind/brains. The generative conclusion has always been that due to the assumed complexity of language structure, babies require help in the form of preexisting domain-specific modules that aid acquisition. To date no single such module has received empirical verification. If, however, language structure is more transparent than the constituency-based view suggests, the need for positing hidden levels disappears.

The current proposal shares with CxGs the conviction that language acquisition is based on domain-general abilities. Following Tomasello (1992, 2003,

2006b), Lieven et al. (1997), Diessel and Tomasello (2001, 2005), Dąbrowksa and Lieven (2005), Diessel (2005), Bybee (2010), and others, construction and usage-based grammars posit that language learners do indeed acquire constructions on the basis of domain-general abilities. Any empirical proof of this proposition should take the catena into account, since the catena describes the structural traits of constructions more efficiently than the constituent.

10. Conclusion

This paper has made a case for the marriage of the theoretical tenets and practical goals of CxGs with a dependency-based understanding of sentence structure. The potential for such a marriage lies with the catena. Units of meaning and structure that lack a concrete expression in constituent-based theories are discernable as catenae. The potential in the marriage lies in part with the ability of the catena to help CxGs overcome their aversion to trees. In this regard, a vague aspect of the constructionist's enterprise becomes concrete and clear.

The two central claims of this paper are repeated here:

Claim 1
Constructions are catenae.

Claim 2
A lexically fixed construct can be broken up by virtue of its co-occurrence with (a) lexically less fixed construct(s). The words of the more fixed construct always form a catena together with the words of the less fixed construct(s).

Claim 1 is tantamount to the insight that all constructs are stored as catenae on the lexicon-syntax continuum, and Claim 2 expresses the insight that even when the words of lexically fixed construct fail to form catenae in surface syntax, their distribution is not arbitrary, but rather it follows predictable patterns.

Finally, one can note that the analysis of constructions and constructs in terms of catenae has focused on the role of catenae in syntax. We believe in this regard that further potential lies with the possibility of extending catenae into words. Further research should demonstrate whether the catena is a profitable concept for theories of morphology as well.

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