Grammar decomposition shows that heads cannot be defined

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Abstract

Since grammar tends to be either head-initial (left-headed) or head-final (right-headed), it seems every language must have a disposition to place the head of a construction in a particular position relative to its subordinates. The problem is that every way of defining heads admits exceptions. Some theorists remain optimistic that a general definition will eventually be found. But as this paper shows, a purely grammatical derivation can never be completely general. The argument uses 'grammar decomposition' as a deductive method. This is a way of unpacking a grammatical analysis into two parts: a conceptual composition capturing hierarchical structure, and a mapping procedure which puts the structure into symbolic form. At this lower level of description, it becomes apparent that headedness stems from an interaction between factors that are conflated in grammatical analysis. The phenomenon can be explained, but a grammatical definition of heads is always inherently incomplete.

Keywords: headedness, concepts, conceptual composition, grammar, verb-phase organization

1 Introduction

Comparative analysis has revealed that languages of the world divide roughly into two groups according to whether they are predominantly head-final (left-branching) or head-initial (right-branching). The effect is most pronounced in the case of pairwise constructions. If a language uses prepositions, it is likely to favor preposed relative clauses with a VO ordering of verb phrases. If it uses postpositions, it is likely to favor postposed relative clauses with an OV ordering (Greenberg, 1963; Dryer, 1992; Croft, 2003). There are approximately the same number of languages of each type. In a sample of 1513 languages, Dryer (2011a) found 713 to have OV organization, and 705 to have VO organization, for example.

The regularity affects constructions of other types, but in a more statistical way. OV languages are likely to also have SOV organization, for example. The effect may also extend into morphology (Hawkins, 1983). It has been noted that suffixing is more strongly preferred in languages that have head-final syntax, for example (Greenberg, 1957; Lieber, 1981; Kiparsky, 1982). The existence of this division into two groups is not in doubt (Bauer, 1990; Zwicky, 1985; Hudson, 1987; Polinski and Ueno, 2009; Melissarapoulou and Ralli, 2008). It is a common assumption that there are 'two vast opposing camps, into which the world's languages seem to be divided roughly half and half' (Deutscher, 2006, p. 301).[1] Explaining the effect, however, has proved difficult. The phenomenon remains a challenging puzzle. As Deutscher asks, 'why is it that languages from all over the world, and even without any family affiliation, seem to converge into two opposing word-order camps, and gravitate towards two diametric poles?' (Deutscher, 2006, p. 302)

Initially, the concept of heads seems unproblematic. It has long been assumed that every syntactic construction has a head element that establishes the construction's syntactic category. The head of a prepositional phrase is the preposition, for example. This idea acquires a formal treatment in the X-bar framework of Chomsky (1970), and in Generalized Phrase Structure Grammar (Gazdar and Pullum, 1981; Gazdar et al., 1985). It can then be supposed that every language has a preference to position heads in a particular way. A language is head-final (initial) just in case it has a preference to position the head element in the final (initial) position. The problem is that it has not been possible to arrive at a general definition of heads (Zwicky, 1985; Croft, 1995; Polinsky, 2012).

The essence of the problem can be illustrated with an example. As Zwicky (1985) notes, the idea of heads rests on the assumption that in any syntactic construct there is one element that dominates the whole. In the case of a prepositional phrase, it is clear what this element is. But in other cases, identification

[1] In Polinsky's (2012) breakdown, Japanese, Korean and Tamil are classified as rigidly head-final; German, Persian, Latin, Tsez, Avar and Basque are classified as non-rigidly head-final; Malagasy, Tongan, most Mayan languages and Irish are classified as clearly head-initial; Indonesian, Ycatec and Mayan are classified as SVO/head-initial; English, Russian, Romance languages and Bantu1 languages are classified as SVO with a mixture of other arrangements.

is more difficult. Determiner phrases are particularly troublesome. Consider the phrase 'the man'. If we interpret this as meaning a man classified as a definite object, the determiner seems to be the dominating element. If we interpret it as a definite object classified as a man, the dominating element seems to be the noun. If either interpretation can be applied, the head cannot be unambiguously identified.[2]

While many ways of defining heads have been proposed (cf. Aronoff and Fudeman, 2011; Carstairs-McCarthy, 2002; Booij, 2007), no agreement has been reached. To this day we lack a fully general definition. Some theorists remain optimistic that one can be found (e.g. Croft, 1995; Hawkins, 2004); others are more sceptical (e.g. Bauer, 1990; Zwicky, 1985). Headedness seems to be a fundamental phenomenon of language. But there appears to be no completely general way of deriving it. As Polinsky remarks

> There is, as of yet, no good explanation for headedness. It is visible; it is rather robust ... but what is it? This question has puzzled many researchers and we still do not know its answer (Polinsky, 2012, p. 348).

The present paper shows what can be accomplished by means of grammar decomposition. This is a way of reducing grammatical analyses to a lower level of description. The method allows any grammatical construction to be decomposed into two parts: a purely conceptual construction capturing hierarchical organization, and a mapping procedure that puts this structure into symbolic form. Every grammatical analysis can be reduced to a combination of two elements in this way. Headedness can then be explained in terms of the way these two elements interact. By moving to a sub-grammatical level of description, it becomes possible to provide an account that does not suffer from the ambiguities that normally arise. The account also reveals the cause of the trouble with grammatical definitions. Since grammatical models conflate the two factors in question, they yield an inherently ambiguous account of what a head is.

The remainder of the paper sets out the account in detail. The material is organized into five main sections. The section immediately to follow (Section 2) examines compositional constructions of a purely conceptual nature, and introduces a flexible way of notating them. Section 3 uses this notation to demonstrate the potential to decompose any grammatical analysis into two parts. Section 4 presents a series of worked examples illustrating how sentences taken from a variety of languages can be dealt with in this way. Section 5 discusses the explanation for headedness that then arises, and Section 6 offers concluding comments.

Some technical points must be noted at the outset. The material dealing with conceptual structures follows the approach of (Murphy, 2002) in avoiding use of special fonts or cases in the naming of concepts. Where there is any ambiguity, the phrase 'the concept of X' is used to indicate that X is a concept name. Phrasal concept names use the dot '.' as a connective; the concept of an ongoing

[2] Arcodia (2012) notes that problems of this type are also often encountered in morphology.

event thus has the name 'ongoing.event'. The material dealing with language (Section 3 onwards) makes use of interlinear glosses as a way of describing grammatical structure. All the glosses presented can also be found in the online resource 'The World Atlas of Language Structures' (Dryer and Haspelmath, 2011). References to this resource use the acronym 'WALS' and relate to its state at May 2015. The internet location of the resource is `http://wals.info`.

2 Conceptual composition

The first step towards the methodology of grammar decomposition is to recognize that concepts are readily put into hierarchical (i.e., compositional) combinations. It poses no difficulty for us to conceive of an X that encompasses a Y and a Z, where X, Y and Z are all concepts (e.g., a residence encompassing a house and a garden). This is the kind of structured thought that we formulate on a regular basis and without conscious effort. Such thoughts can also be extended to any desired level of construction. We can envisage the case where the Z itself encompasses a B, D and E, for example. (This might be the situation where the garden is made up of a lawn, path and flower-bed.) Given any number of levels can be added in principle, this constructive mechanism is a compositional apparatus akin to linguistic syntax. The conceptual system is inherently compositional in this sense.

Despite (or perhaps because of) the familiarity of this process, there is as yet no established way of notating hierarchical concept combinations. It is necessary to introduce a formalism for this. The one adopted here is designed to capture hierarchical structure by means of bracketing. An individual construction is expressed as a square-bracketed list, in which the encompassing concept is placed immediately before the encompassed concepts. Concepts themselves are represented either by name or by construction. On this basis, the concept of an X encompassing a Y and a Z is expressed by

[**X** Y Z]

The encompassing concept is distinguished by placing it first in sequence. (It is also emboldened for added emphasis.) If the Z is seen as encompassing a B, D and E, an embedded construction of the relevant form is incorporated. The expression then acquires two levels of bracketing corresponding to the two levels of construction:

[**X** Y [**Z** B D E]]

What this denotes is the concept of an X that encompasses a Y and a Z, where the Z itself encompasses a B, D and E. The concept of a residence encompassing a house and garden, where the garden itself encompasses a lawn, path and flower-bed thus has the form

[**residence** house [**garden** lawn path flower-bed]]

Key to this notation is placing the encompassing concept first in any construc-

tion. It is akin to a prefix or 'Polish' notation in this respect. Since expressions are explicitly bracketed, and since they evaluate to concepts rather than numbers, it is not a true prefix notation. What the approach achieves is a direct correspondence between bracketing and hierarchical structure. A more functional style of notation, which places the opening bracket of a construction after the constructive element, would not do this.

Another point to note is that encompassed concepts are not considered to be in any order. They form a set, in other words. Thus, it is true by definition that

[**X** Y Z] = [**X** Z Y]

The initial element of a construction is said to be the encompassing (or constituted) concept. The remaining elements are the encompassed (or constituting) concepts. Using this notation, it becomes possible to explore the possibilities of hierarchical conceptualization. The simplest constructions of all utilize a single level of composition. As an illustration, consider the case where we are provided with the following set of basic concepts:

{burger, fries, meal}

Three concepts are given: the concept of a burger, the concept of fries, and the concept of a meal. Using concepts taken from this set, we can then construct the concept of a meal made up of a burger and fries. The notation for this is

[**meal** burger fries]

We can also construct the concept of a meal constituted *solely* of fries:

[**meal** fries]

Another possibility is the concept of a meal constituted solely of a burger:

[**meal** burger]

Constructions with a single encompassed element (termed 'singles' below) are naturally seen as classifications. The one above can be seen as the classification of a burger as a meal. It is the concept of a burger that is also classified as meal. Notice that such constructions are also inherently reversible. An X that is classified as (constituted of) a Y can equivalently be seen as a Y classified as (constituted of) an X. There are two equivalent formulations of any such construction; it is true by definition that

[**X** Y] = [**Y** X]

No other constructions can be formed out of the three concepts provided. But imagine that we are now given the following, slightly larger set:

{singer, drummer, duo, guitarist, band}

A number of constructions can now be expressed. First, there are three versions of the duo concept:

[**duo** singer guitarist]
[**duo** singer drummer]
[**duo** guitarist drummer]

These express, respectively, the concept of a singer-guitarist duo, the concept of a singer-drummer duo, and the concept of a guitarist-drummer duo. Pressing two of these into service as constituents, we can then build the concept of a band of two duos:

[**band** [**duo** singer guitarist] [**duo** guitarist drummer]]

This expresses the concept of a band made up of two duos: a singer-guitarist duo and a guitarist-drummer duo.

Notice that where an encompassing concept of a relational character is applied to more than one constituting concept, the effect is that of a schematic construction. An example that particularly highlights this effect is

[**understanding** teacher lawyer]

This expresses the concept of an understanding encompassing a teacher and a lawyer. More intuitively, it an understanding between a teacher and a lawyer. Implicitly, what is constructed is a relational schema. But notice that no schema-making apparatus is involved. Deployed as the encompassing entity, the concept of understanding provides all that is required. It becomes the 'glue' that holds the two constituents together. It fulfils the role of constructive operator. The relational arrangement is captured purely by compositional construction—by deploying one concept as the encompassing entity.

A construction of this sort can also be given embedded elements as a way of differentiating roles. For example, we might write

[**understanding** [**agent** teacher] [**recipient** lawyer]]

This expresses the concept of an understanding encompassing a teacher and a lawyer in which the teacher is specifically classified as agent, and the lawyer is specifically classified as recipient. It is the concept of a teacher understanding a lawyer, rather than vice versa. The process of adding levels of construction can continue as long as we like. We might write

[**improvement** [**understanding** [**agent** teacher] [**recipient** lawyer]]]

This adds a new layer of meaning: the teacher's understanding of the lawyer is now classified as an improvement (i.e., as improving). Increasingly complex compositional constructions can be built up in this way. It is possible to show all the standard forms of conceptual representation can be realized by hierarchical combination. But for present purposes, what is of interest is the way constructions of this type can give rise to the utterances of language.

3 Grammar decomposition

Using the bracketing notation it is possible to show that any grammatical utterance can be seen as a conceptual composition put into symbolic form. The demonstration uses the fact that we can decompose any grammatical structure into two constituents: a conceptual construction capturing hierarchical and semantic content, and a mapping procedure that puts the structure into symbolic form. The reduction has two steps. The first step is to convert every grammatical entity within the structure to a semantically equivalent conceptual entity. The second is to capture the semantic implications of symbol-ordering by addition of classifications.

The process can be illustrated using the English sentence 'John sees the book.' This takes the form of a verb phrase in which 'sees' is the verb, 'John' is the subject, and 'the book' is the object. The grammatical structure can be analyzed as follows:

$$(_{\text{VP}} \text{ sees } (_{\text{N}} \text{ John}) \ (_{\text{NP}} \ (_{\text{DET}} \text{ the}) \ (_{\text{N}} \text{ book})))$$

The structure is decomposed as follows. The first step is to replace each grammatical constituent with a semantically equivalent conceptual constituent. In the simplest case, the constituent is a content word, and the replacement is just the corresponding concept. The two content words here are 'John' and 'book'; both can be seen as concept names in their own right, so no change is needed. The second step involves replacing each grammatical construction with a semantically equivalent conceptual construction. This is a hierarchical concept combination in which the encompassing concept has the grammatical meaning that the grammatical construction imposes on its subordinate elements. In this case there are two grammatical constructions: the verb phrase and the noun phrase. In the latter, the word 'the' is a definite article (an ART.DEF) which imposes the meaning of being a definite thing on the subordinate entity 'book'. This construct is thus replaced with

[**definite.thing** book]

The verb 'sees' imposes the meaning of a seeing action on the subordinate subject and object. This is thus replaced with the construction

[**seeing.action** John [**definite.thing** book]]

This expresses the idea of a seeing action encompassing John and a definite book. Still missing is any discrimination of subject and object—the effect achieved by the SVO ordering of the phrase. The final step in the process is to add the implied classifications. The final structure then becomes

[**seeing.action** [**subject** John] [**object** [**definite.thing** book]]]

With John classified as subject, and the book as object, this expresses the idea of John seeing a definite book. The conceptual construction redeploys grammatical meanings in a way that replicates the original construction. The idea obtained

is thus the one expressed by the original utterance. Grammatical structure can be converted to hierarchical conceptual structure in this way. But notice the relationship is strictly functional. There is no 1-to-1 isomorphism. There cannot be one, since grammatical structure has ordered branches, whereas conceptual structure does not.

Next, we require a mapping procedure. This is the method that will put the conceptual construction back into symbolic form, producing the original utterance. Its main task is to turn concept-names back into content words. But there is the problem of ordering to consider. Each conceptual construction uses two or more concepts, which give rise to two or more symbols. Their ordering is not defined by the construction itself, however. A symbol-positioning procedure has to be assumed that reproduces the correct ordering in each case. This must also invert any ordering-derived classifications.

In the present case, a strategy of 'initial positioning' suffices. Applied to a concept-name, this produces the corresponding content word. Applied to a construction, it obtains (by recursion) the symbolic form for each element and then places the form derived from the encompassed concept first. Assuming the regime also correctly inverts the ordering-derived classifications, the sequence then obtained is the one we want: 'John sees the book'.

Using this method, any grammatical analysis can be broken down into a hierarchical concept combination, and a mapping procedure that puts the construction into symbolic form. Any grammatical utterance can thus be seen to be the product of cooperation between the conceptual and linguistic systems. It can be regarded as a construction of one that is symbolically encoded by the other. A grammatical utterance can be seen to be a compositional conceptual construction put into symbolic form in a particular way.

3.1 Worked example

How does the decompositional process work in the case of non-English sentences? The next few sections set out illustrations involving a variety of other languages. The initial example focuses on a sentence of Japanese. The illustration begins by considering the grammatical structure of this sentence. Its decomposition into two parts is then examined. The utterance in question is

Johnga tegamio yonda

This translates as 'John read the letter'. The grammatical structure of the utterance is analyzed by Kuno (1973, p. 10; WALS, Ch. 82, Ex. 2) as follows.

John-ga	*tegami-o*	*yon-da*
John-SUBJ	letter-OBJ	read-PST

'John read the letter'

The sentence takes the form of a verb phrase incorporating two role-marked nouns: *John* marked as subject (SUBJ), and *tegami* marked as object (OBJ). How does the decompositional process work in this case? From the analysis, we

can deduce that the mapping of symbols (i.e., content words and morphemes) to concepts in this case should be as follows.

John → John
o → definite.object
tegami → letter
da → past.behavior
yon → reading.action
ga → subject

The subject-marked noun *John-ga* then converts to the classification

[**subject** John]

The object-marked noun *tegami-o* converts to the classification

[**definite.object** letter]

and the tense-marked verb *yon-da* converts to

[**past.behavior** reading.action]

The utterance itself then yields the structure

[[**past.behavior** reading.action][**subject** John] [**definite.object** letter]]

In this case the main encompassing idea is a construction itself. (Notice the emboldened brackets.) It is the concept of a reading action that is classified as past behavior (i.e., a reading action in the past). Taken as a whole, the construction expresses the idea of a past reading action encompassing John (classified as subject), and a letter (classified as definite object). It expresses the idea of John reading a particular letter sometime in the past. The meaning is the one expressed by the original utterance.

The symbol-positioning needed in this case is, again, very simple. We require 'final positioning' to be applied throughout. The symbolic form of an encompassed concept should always be placed after the forms for encompassed concepts. Applying this strategy produces a sequence of six symbols: *John ga tegami o yon da*. Assuming these are uttered with conventional word-breaks, what is then obtained is the original Japanese sentence:

Johnga tegamio yonda

The two components obtained by the decompositional process are the semantic composition (conceptual construction) and the symbol-positioning regime. In combination, they form an explanatory unit which is generative in nature. The conceptual structure captures the utterance's semantic/hierarchical form. Application of the symbol-positioning regime yields the relevant sequence of symbols. The generative power of the two components in combination is identical to that of the grammatical analysis.

Given this way of breaking down the analysis of *Johnga tegamio yonda*, it is possible to take a sub-grammatical view of the way the utterance is produced.

Instead of thinking of it originating in an act of grammatical construction, we can think of it originating in an act of semantic construction. Putting the construction into symbolic form can then be seen as a second stage in the process.

The way individual grammatical constructions emerge then becomes of interest. Consider *John-ga*, for instance. The origin of this is the classification of John as subject:

[**subject** John]

But the positioning regime also plays a role: it is this which leads to the subject marker *ga* being attached as a suffix rather than a prefix. In a similar way, the construction *tegami-o* can be seen as a product of the positioning strategy and the classification

[**definite.object** letter]

The verbal construction *yon-da* is the product of the positioning strategy and the classification

[**past.behavior** reading]

The SOV organization of the verb phrase comes from the positioning strategy alone. Each grammatical construct can be traced back in this way to an interplay between semantic construction and symbol-positioning.

3.2 Arawak example

What about more complex sentences? The following example examines a sentence taken from the Suriname language of Arawak. The decomposition of the grammatical analysis in this case yields a more complex semantic composition. The utterance in question is

Miaka aba wadili sika khali damyn.

This translates as 'Yesterday a man gave cassava bread to me'. The grammatical structure is analyzed by Pet (1987; see also WALS, Ch. 84, Ex. 4) as follows.

Miaka	*aba*	*wadili*	*sika*	*khali*	*da-myn*
yesterday	INDEF	man	give	cassava.bread	1SG-to

'Yesterday a man gave cassava.bread to me'

From this analysis, we can deduce the following mapping of symbols to concepts:

khali → cassava.bread
sika → giving.action
aba → indefinite.entity
myn → indirect.object
wadili → man
da → myself

miaka → yesterday.event

Translation of the grammatical structure then produces the following conceptual composition.

[**yesterday.event**
  [**giving.action**
    [**indefinite.entity** man]
    cassava.bread
    [**me** indirect.object]]]

In this case, there are three levels of conceptual construction corresponding to the three levels of grammatical construction. The formulation also incorporates a 'triple', a construction with three encompassed concepts. Previously, all constructions have been either 'singles', constructions with one encompassing concept, or 'doubles', constructions with two.

The key element is the initial encompassed concept. This expresses the idea of a giving action encompassing an indefinite man, cassava bread and an indirect object classified as 'me'. Given the reversibility of singles, the effect of the latter is to classify 'me' as indirect object of the action. On this basis, the preceding two constituents are implicitly classified as subject (agent) and object respectively. What emerges is the idea of an indefinite man giving cassava bread to 'me'. This is itself classified as a 'yesterday.event', i.e., an event occurring yesterday. The final product is thus the idea of a man giving cassava bread to 'me' yesterday. This is the meaning of the original utterance.

In the previous example, a strategy of final positioning was found to suffice throughout. Here, we need 'medial positioning' to be applied where possible, and 'initial positioning' otherwise. In initial positioning, the symbol for the encompassing concept is placed before the symbolic form of the encompassed concept. In medial positioning, it is placed centrally. The latter can only be applied with constructs of two or more encompassed concepts, and it is assumed that the positioning regime produces a particular ordering of the latter before inserting the symbolic form of the encompassing concept as second element. For convenience, this ordering is assumed to be the left-right ordering seen in the original construction. It is important to remember that the conceptual construction itself assumes no such ordering, however.

Applying this regime to the structure generates a sequence of seven Arawak symbols: *Miaka aba wadili sika khali da myn.* With standard word-breaks imposed, this becomes the desired utterance

Miaka aba wadili sika khali damyn.

3.3 Yagaria example

A useful feature of the method is that it allows novel generalizations to be captured. With a distinction made between semantic composition and symbol-

positioning, it is possible to capture commonality in one factor alone. If utterances taken from different languages are found to derive from the same conceptual structure, that structure captures what they have semantically in common.

The effect can be illustrated using the previously derived Japanese sentence *Johnga tegamio yonda*. Recall that this was obtained from

[[**past.behavior** reading.action] [**subject** John] [**definite.object** book]]

Given a different symbol-positioning regime, the same structure can also give rise to the English translation 'John read the letter'. For this, the mapping from symbols to concepts must be as follows.

John → John
read → [past.behavior reading.action]
book → book
the → definite.object

The required generative regime uses medial positioning where possible, and initial positioning otherwise. What we then obtain is *John read the letter*. The fact that both Japanese and English sentences can be derived from the same conceptual construction captures the fact that they are identical in semantic structure.

Distinguishing semantic composition from symbol-positioning also makes it easier to manipulate one factor independently. It becomes possible to show how variation of linguistic form can stem entirely from variation in conceptual form. Consider this analysis from (Renck, 1975, p. 84; see also WALS Ch. 144, Ex. 94):

No'-a'-l-ag-e
PROGR-NEG-1PL-see.3SG-INDIC
'He/she is not seeing us'

The utterance in this case is *No'a'lage*. This five-morpheme word is taken from the highly synthetic language of Yagaria, spoken in Papua New Guinea. The English translation is 'He/she is not seeing us'. From the analysis we can deduce that the appropriate mapping of symbols to concepts in this case is as follows.

a' → counterfactual
e → identified.idea
no' → ongoing.event
ag → seen.entity
l → us

Conversion of the grammatical analysis then yields the following conceptual structure:

[[**ongoing.event** [**counterfactual** [**seen.entity** us]]]
identified.idea]

Here, the encompassing concept is a construction of three levels. At its base we have

[**seen.entity** us]

This classifies 'us' as a seen.entity, expressing the idea of 'us' being seen. This is then classified as a counterfactual situation (something that is not the case) and an ongoing event. This yields the concept of 'us' *not* being seen in an ongoing way. This is then itself classified (by reversal) as an identified idea. For this case, we again require final positioning throughout. This produces the sequence of five morphemes *No' a' l ag e*. Assuming these are uttered without word-breaks (as would be conventional in this language) we recover the original five-morpheme word.

It will be seen that there are other ways of constructing the idea in question, however. Consider this alternative:

[**attribution** [**male** person] [**counterfactual** seeing.action] us]

This expresses the idea of an attribution encompassing a male person, a counterfactual act of seeing, and 'us'. Assuming that in an attribution involving an action, the person (concept) is implicitly classified as subject, classification of 'us' as object is implicit. What is expressed is, again, the idea of 'us' not being seen, although here we have the addition of it being a male person who fails to do the seeing. In content, it is much the same idea as before. The way it is assembled is very different, however.

This way of expressing the idea can also yield a grammatical utterance, but in English rather than Yagaria. For this we require medial/initial positioning and a mapping of concepts to symbols as follows:

he → [male person]
is → attribution
not → counterfactual
seeing → seeing.action
us → us

What is then obtained is a sequence of five words forming the English statement *he is not seeing us*. Different ways of formulating an idea compositionally can give rise to differently constructed expressions in different languages in this way.

3.4 Zulu example

A more extreme form of generalization arises where utterances from different languages are found to share both semantic composition and positioning strategy. In this case, it is purely the way symbols map to concepts that distinguishes the utterances. An illustration can be set up using the following analysis of an utterance taken from Zulu, a language spoken in South Africa (Ziervogel et al., 1981; see also WALS, Ch. 124, Ex. 1):

Ngi-funa *uku-dlala* *na-ye*
1SG-want INF-play INSTR-him
'I want to play with him'

The utterance in this case is *Ngifuna ukudlala naye*. This translates as 'I want to play with him'. From the analysis we can infer that the appropriate mapping of symbols to concepts in this context is as follows:

ye → [male person]
uku → in.commission
na → instrumental.means
ngi → me
dlala → playing.behavior
funa → state.of.wanting

Conversion of the analysis then yields the following conceptual structure:

[**state.of.wanting**
me
[**in.commission** playing.behavior]
[**instrumental.means** [**male** person]]]

This expresses the idea of a state of wanting encompassing 'me', the commission of a playing behavior (i.e., a playing behavior classified as in commission), and a male person. Given the latter is an 'instrumental means', classification of 'me' as subject is implicit. We also have implicit classification of the playing behavior as object. Accordingly, what is constructed is the idea of 'me' wanting to commit a playing behavior with a male person. This case requires medial/initial symbol-positioning (i.e., medial positioning where possible and initial positioning otherwise). What is then obtained is the sequence of six morphemes *Ngi funa uku dlala na ye*. With standard word-breaks imposed, this becomes the original sentence.

Exactly the same semantic composition and positioning strategy, applied with a mapping to English symbols, produces the English translation. The mapping in this case is

him → [male person]
to → in.commission
with → instrumental.means
I → me
play → playing.behavior
want → state.of.wanting

We then obtain the English sentence *I want to play with him*. The Zulu and English sentences are found to be identical in both semantic composition and symbol-positioning. With both factors held in common, their close relationship comes to the surface in the grammatical analysis too: it exposes the commonality just as well as a sub-grammatical analysis in this case. But the latter

has the advantage of giving an account that explicitly distinguishes semantic composition from symbol-positioning.

4 Discussion

Grammar decomposition offers a useful way of getting under the surface of the phenomenon of headedness. It leads to a natural explanation of how the phenomenon arises, but also—ironically—to the realization that a purely grammatical definition of heads cannot be completely general. On a sub-grammatical view of language, utterances are seen to derive from the way semantic constructions are put into symbolic form. The surface forms of language are seen to be partly due to semantics, and partly syntax. But the syntactic contribution is then seen to be very restricted in form. Syntactic variation derives from variation in symbol-positioning alone.

In principle, every distinct semantic construction can be put into symbolic form using a different symbol-positioning regime. In practice, there is inherent pressure towards a uniform approach. Only two strategies can deal with structures of the simplest and most common form. Every language is compelled to use either initial or final positining in the case of singles. It has the option to adopt a more complex approach in the case of structures of higher denomination. But such variation accomplishes nothing of an essential nature, since the generic strategies are themselves universally effective. Such additional complexity must also increase processing costs in some way. Therefore, the two generic strategies should exert a strong 'gravitational pull' cross-linguistically. Languages should cluster around these two regimes.

This yields the desired prediction—it predicts the phenomenon we call headedness. Given the assumption that function words derive from encompassing concepts, initial positioning applied to singles gives rise to right-branching grammatical pairs, and final positioning gives rise to left-branching grammatical pairs. A tendency for languages to gravitate towards one of the two strategies is expected. If a language uses prepositions, it is likely to favor preposed relative clauses with a VO ordering of verb phrases. If it uses postpositions, it is likely to favor postposed relative clauses with an OV ordering, and so on.

At the same time, this explanation reveals there cannot be a purely grammatical definitions of heads. Whether something is a head is seen to depend on whether it stems from an encompassing concept. But whether a concept is encompassing or encompassed cannot be determined in general. As noted above, the classification is strictly undetermined in the case of singles. Accordingly, there cannot be a definition which reliably picks the head from a set of elements. This does not mean a definition cannot succeed up to a point. To the extent that a certain type of concept is *typically* deemed the encompassing element, a definition of heads based on the grammatical identity in question will succeed.

Grammatical head definitions can work in this constrained sense. This explains their success in dealing with prepositional constructions, for example

(Hudson, 1987). A preposition derives from a relational concept, i.e., a relationship that can be had with another entity. Treating such a concept as the constituting element in a construction is nonsensical: such a concept is bound to be treated as the encompassing element. A definition which makes the preposition the head of a prepositional phrase will always succeed for this reason. Where the grammatical element derives from a concept that can naturally play either encompassed or encompassing role (e.g., one that gives rise to a determiner) the implied definition is liable to fail.

However successful a grammatical definition of heads is found to be, it is inherently error-prone in this sense. It will always be possible to find (or generate) exceptions. The attempt to derive such a definition is fated to be a troublesome undertaking. In practice, the search for a definition of heads has been controversial from the outset (Croft, 1995). A seminal exploration of the ways in which such a definition can be constructed is provided by Zwicky (1985). In Zwicky's view,

> The intuition to be captured with the notion HEAD is that in certain syntactic constructs one constituent in some sense 'characterizes' or 'dominates' the whole. (Zwicky, 1985, p. 2)

Zwicky explores a wide range of possibilities, including a purely semantic definition.[3] Many ways of capturing the idea of a dominating head constituent have also been considered by other theorists. Hudson sees the head as 'the element in some construction to which all the other parts of that construction are (in some sense) subordinate' (Hudson, 1987, p. 109). Booij sees it as 'the element in a construction that determines the properties of that construction' (Booij, 2007, p. 314). Aronoff and Fudelman see it as 'a word in a syntactic construction or a morpheme in a morphological one that determines the grammatical function or meaning of the construction as a whole' (Aronoff and Fudeman, 2011, p. 264; cf. Carstairs-McCarthy, 2002). But, as Zwicky (1985) foresaw, and as the present analysis predicts, a fully general definition—one without exceptions—has never materialized (Arcodia, 2012; Polinsky, 2012; Bauer, 1990).

In the face of this failure to determine a general definition, the underlying puzzle of headedness comes more to the fore. On a grammatical view, it is not immediately obvious why contrasting grammatical constructions should to be put together according to a common plan. The diachronic evidence suggests that the choice a language makes between VO and OV ordering percolates out to effect completely different constructions. But why should this be? As Deutscher (2006) asks

> Why should the alignment of the verb and object have any bearing on the choice between head noun and the appendage noun, when

[3]The essence of this is that 'in combination X + Y, X is the 'semantic head' if, speaking very crudely, X + Y describes a kind of thing described by X' (Zwicky, 1985, p. 4). A notion that Hudson describes as 'very insightful' (Hudson, 1987, p. 113), this is close to the idea of conceptual constitution around which the present analysis is based.

> (as opposed to prepositions and auxiliaries) the possessive construction could not have developed directly from the verb-object couple?' (Deutscher, 2006, p. 304).

On a grammatical view, there is no obvious reason why phrasal organization should generalize in this way. On a sub-grammatical view, the explanation emerges more clearly: all such structures stem from singles, and it is unsurprising if they are dealt with in a uniform way. Focussing on the conceptual constructions that underlie grammatical constructions, the observed generalization of syntactic strategy is expected.

A distinctive feature of the proposed explanation is that it gives rise to some novel predictions of left-right asymmetries. One of these relates to verb-phrase ordering. According to the sub-grammatical view, final and initial positioning are perfectly balanced alternatives. There should be a roughly even split between OV and VO ordering, and this is found to be the case (Dryer, 2011a). Given the gravitational pull of the two generic regimes, languages are then predicted to deal with transitive verb phrases by the least problematic extension of whichever generic strategy is adopted. Given the strong bias away from orderings which place object before subject, it follows that OV languages will tend to adopt SOV ordering, while VO languages will tend to adopt SVO ordering. Accordingly, SOV and SVO ordering should dominate cross-linguistically. Again, this is confirmed empirically. Out of a sample of 1377 languages, Dryer (2011b) notes that 565 are SOV and 488 are SVO.

A second prediction relates to noun-verb ratios. According to the sub-grammatical view, languages should exhibit left-right asymmetries in verb usage depending on the extent to which they use initial or final positioning. Where initial positioning is used, the encompassing concept is identified before the encompassed constituents. If final positioning is used, it is the other way around—the encompassed constituents are identified first. Given the encompassing concept is the 'framework' into which the encompassed concepts must fit, specifying it in advance can only reduce ambiguity as to how they do so. On this argument, the strategy of initial positioning is better placed to deal with more encompassed concepts. Languages using initial positioning are in a better position to exploit constructions of higher denomination. In grammatical terms, such constructions are verb phrases. The prediction that follows is thus that head-initial languages will tend to make more use of verbal constructions than head-final languages; i.e., the noun-verb ratio should be higher in the latter.

Some evidence of this effect has been observed. A study by Polinsky revealed a 'correlation between headedness and the proportion of verbs in the lexicon' (Polinsky, 2012, p. 355). More utilization of left-branching structure was found to be associated with a higher noun-verb ratio, as predicted. Polinksy comments that

> The results may be surprising: there is a robust correlation between headedness and the proportion of verbs in the lexicon. Head-final, OV languages have a relatively small percentage of simple verbs,

> whereas head-initial languages have a considerably larger percentage of simple verbs. (Polinsky, 2012, p. 355)

This asymmetry in verb usage may also relate to the suffixing preference in morphology. This effect was first noted by Sapir, who commented 'Of the three types of affixing—the use of prefixes, suffixes, and infixes—suffixing is much the commonest.' (Sapir, 1921, p. 67). Interest in it was particularly stimulated by Greenberg's observation that suffixing is more preferred in head-final languages (Greenberg, 1957, 1963; see also Clair et al., 2009). According to one school of thought, languages continuously convert syntax to morphology (Givón, 1979), as in the slogan 'yesterday's syntax is today's morphology.' If left-branching languages make relatively more use of simple paired constructions, one would expect them to supply suffixal morphology more effectively. What we take to be a global preference for use of suffixing might thus be the consequence of the relative ease with which left-branching languages supply new morphology. Whether this account can be put on a more detailed footing is something future work will seek to clarify.

5 Concluding remarks

The divide between left- and right-branching grammatical organization is an intriguing phenomenon of language. A highly visible effect cross-linguistically, it has proved hard to account for in grammatical terms. By definition, a grammatical diagnosis must assume the effect has a grammatical origin. Every construction has to be assumed to have a grammatical head, such that every language can have a preference for placing this head in a particular position relative to its subordinates. The problem is that every way of defining heads seems to admit exceptions.

Grammar decomposition can explain both why the phenomenon occurs, and why it is difficult to explain grammatically. The approach reveals two fundamental dichotomies: one separating initial-positioning from final-positioning, the other separating encompassed and encompassing concepts. Patterns of headedness are then seen to reflect the way these dichotomies interact. What is significant is how a language's choice of symbol-positioning *interacts* with the statistical tendencies of concepts to play the encompassing role in conceptual constructions. There are two, independent factors at work. Languages are expected to divide, but in a way that can only be explained by an analysis that distinguishes the two factors. Since grammatical analysis conflates them, it cannot fully explain the effect.

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