Compositionality in Quantifier Words

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International Workshop on the Syntax/Semantics Interface
Institute of Linguistics, Academia Sinica, Taipei, June 17-18, 2011

Compositionality: The meaning of a complex expression is a function of the meanings of its parts and how they are put together.

What are the "parts"? This question can be asked in many ways: Surface constituents? LF constituents? Only audible parts? Also phonetically empty ones? What about type shifters? Etc.

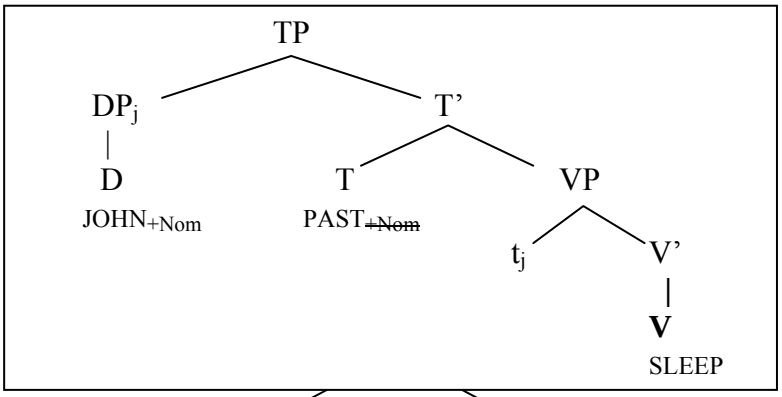
Today's question: Are **phonological words** the **smallest parts** that a compositional grammar should take into account? If not, what smaller parts are to be recognized?

1. Background: lessons from Distributed Morphology, some versions of Minimalist Syntax, and some recent work in formal semantics:

1.1 Distributed Morphology (Halle & Marantz 1994; Embick 2010; and others)

- Hierarchical syntactic structure all the way down to roots; Late Insertion of vocabulary items. This architecture is compatible with various different theories of locality and linearization.
- The typological differences between polysynthetic and isolating languages do not require the postulation of radically different combinatoric and compositional mechanisms in UG. The phonological word has no special status in semantic interpretation.

Example: *John slept* (Harley 2011)



Linearization, Morphological Merger, Late Insertion, Phonological constraints

SLEEP ⇔ /slEp/ [[PAST]$_T$ ___]
PAST ⇔ /d/
[[/dZAn/]$_{DP}$ [/slEpd/]$_{VP}$]$_{TP}$]
[>>dZAn >>slEpt]

LF Interpretation

VP: ιi[∃e[SLEEP(e, John) & DURING(e,i)]]
TP: BEFORE(utt-time, ιi[∃e[SLEEP(e, John) & DURING(e,i)]])

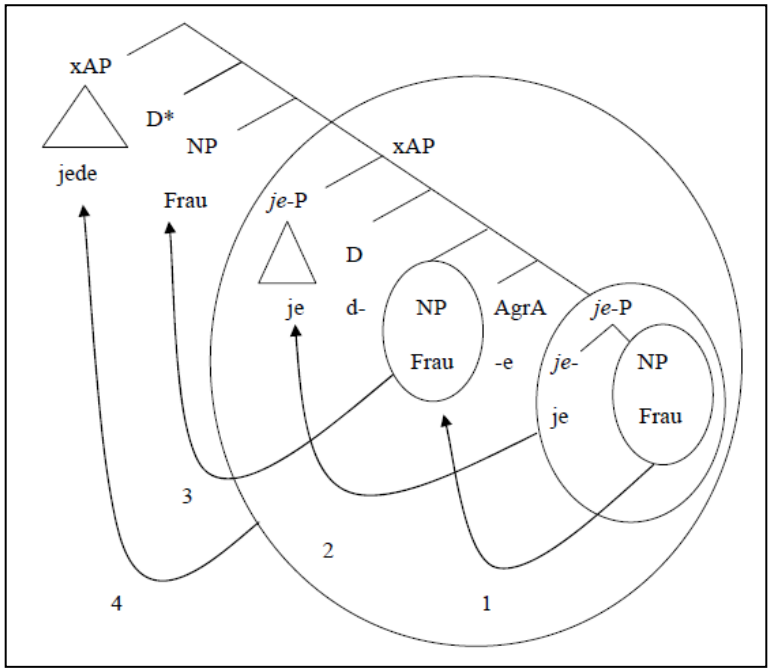
1.2 Some versions of Minimalist syntax (Koopman & Szabolcsi 2000; Julien 2002; Sigurðsson 2004; Koopman 2005; Kayne 2005a,b, 2010; Starke 2009; and others)

- Each syntactic head carries one and only one feature. Then, phonological words correspond to potentially large chunks of syntactic structure.
- Especially when remnant movement is allowed, many words will not even correspond to complex heads assembled by head movement in syntax, because at least some of the building blocks are phrases.

Example: German *jede Frau* `every woman' (Leu 2010)

jeder = *je* `distributive particle' + *d* `relative complementizer' + adjectival agreement
and not: *je* + definite article + article agreement

cf.	je – d – er Mann `every man'	gut-er Mann `good man'	vs. d-er Mann `the man'
	je – d – **e** Frau	gut-**e** Frau	vs. d-**ie** Frau
	je – d – **es** Kind	gut-**es** Kind	vs. d-**as** Kind

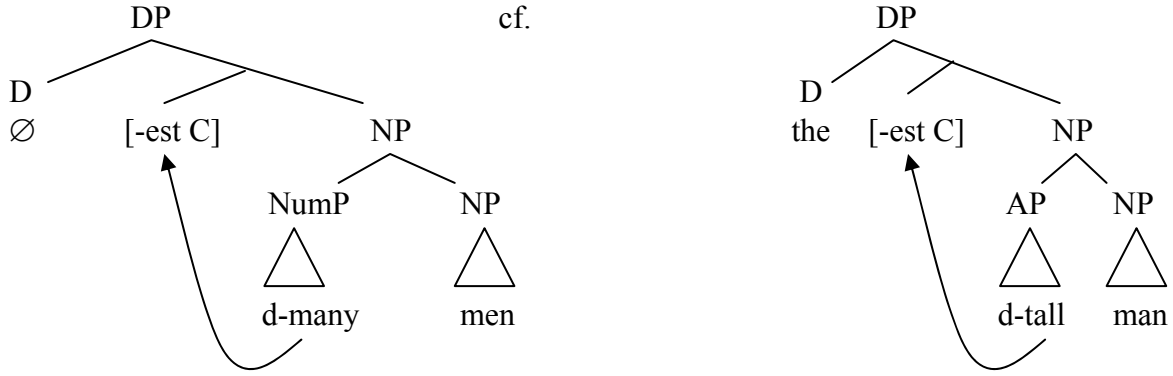


1.3 Some recent work in formal semantics (see Szabolcsi 2010 for a survey)

Example: the determiner *most* (Hackl 2009)

Classical, word-based interpretation:
MOST(MEN)(SNORE) = |MEN ∩ SNORE| > |MEN ∩ NOT SNORE|
Does not in any way reflect the fact that *most* is the superlative of *many* and *more*.
Makes it seem accidental that *Fewest men snore* does not mean `Fewer men snore than do not snore' and is in fact not acceptable at all.

Goal: Assemble the proportional reading of *most* from the independently motivated meanings of *many* (as in *how many*) and superlative *–est,* with Heim's (1985, 1999) semantics for absolute superlatives.



MANY (d)(P) = λx[P(x) ∧ |x| ≥ d]
`the set of pluralities *x* with property *P* (e.g. men) and with cardinality at least *d*'

Presupposition: -EST(C)(D)(x) is defined iff *x* has an alternative in the context set C of things with some degree of D-ness. (If D=blue, then members of C are somewhat blue, if D=cardinality, then members of C are not empty, ...)
Assertion: If defined, -EST(C)(D)(x) is true iff
∀y[(y ∈ C ∧ y ≠ x) → max{d : D(d)(x)} > max{d : D(d)(y)}]
`in the set C of pluralities, *x* has a greater degree of D-ness than any other *y*'

Two pluralities are distinct iff they do not overlap. All possible ways of carving C into competing pluralities must be considered for cardinality comparison.

Most men snore is true if and only if there is a plurality of men whose cardinality is greater than that of any other non-empty plurality of men in C, and the members of this plurality snore. Equivalent to *More men snore than don't snore*, but compositionally derived.

**Fewest men snore*: the same grammar, extended to *least*, does not compute a viable interpretation for it.

2. Interim conclusions

(i) Words are not distinguished building blocks in syntax or morphology.
(ii) Words are not the minimal units for compositional semantics.

Caveat: It is possible to define a grammar without any movement and thus to assign correct interpretations to surface constituents (Jacobson's direct compositionality), phonological words among them. The main point of (i) is that empirical generalizations **do not force** us to recognize words as distinguished building blocks outside phonology.
E.g. the semantics of *most* (both absolute and relative readings) can be given without LF-movement, replicating Hackl's results using Cresti's (1995) semantics for (*how) many* and Heim's (1985) semantics for superlatives as ingredients. Crucially, (ii) remains a solid conclusion.

3. In what follows I point out a set of cases where recognizing sub-word compositionality seems particularly illuminating, but also raises challenging questions

3.1 Are these particles multi-functional, or their uses have a unified semantics?

Japanese **ka** and **mo** (Nishigauchi 1990; Yatsushiro 2002; Shimoyama 2006; and others)

(1)	a.	Tetsuya-**ka** Akira-**ka**	'Tetsuya or Akira'
	b.	dare-**ka**	'someone'
	c.	dono NP-**ka**	'some NP'
	d.	Dare-ga odorimasu **ka**	'Who dances?'
	e.	Akira-ga odorimasu **ka**	'Does Akira dance?'

(2)	a.	Tetsuya-**mo** Akira-**mo**	'Tetsuya and Akira'
	b.	dare-**mo**	'everyone/anyone' (depending on stress)
	c.	dono NP-**mo**	'every/any NP' (depending on stress)
	d.	Tetsuya-**mo**	'also/even Tetsuya' (depending on stress)

Hungarian **vagy**-/**vala**- and **és**/**is**, **mind**- (Hunyadi 1989)

(3)	a.	Kati **vagy** Mari	`Kate or Mary'
		vagy Kati, **vagy** Mari	`either Kate or Mary, not both'
	b.	**vala**-ki	`someone'
	c.	**vala**-melyik/**vala**-mi NP	`some NP'
	d.	--	[no constituent-question complementizer]
	e.	**Vaj**-on táncol(-e) Kati?	`I am wondering .../ Could it be that ...'
	f.	**vagy**-/**vala**-	stems of the existential and locative copula

(4)	a.	Kati **és** Mari	`Kate and Mary'
		Kati **is**, Mari **is**; **mind** Kati, **mind** Mari	`both Kate and Mary'
	b.	**mind**-en-ki	`everyone'
	c.	**mind**-egy-ik NP, **mind**-en (egy-es) NP	`each NP, every (single) NP'
	d.	Kati **is**	`also/even Kate'

See Ramchand (1997) for Bengali; Jayaseelan (2001) for Malayalam; Amritavalli (2003) for Kannada; Borzdyko (2004) for Belorussian; Paul (2005) for Malagasy; Zimmermann (2009) for Korean and Hausa; Haspelmath (1997) and Gil (2008) for a typological perspective.

3.1.1 One unifying option: purely denotational semantics

$\exists$ / $\vee$ and $\forall$ / $\wedge$ in finite universes where all individuals have names, e.g. U = {Kate, Mary, Joe}

Someone dances	iff	Kate dances, **or** Mary dances, **or** Joe dances (possibly all)
Everyone dances	iff	Kate dances, **and** Mary dances, **and** Joe dances

Suggests that the morpheme that serves as `some' and `or' may show up in all constructions whose semantics crucially involves existential quantification or disjunction. Same for the morpheme that serves as `every' and `and' with universal quantification and conjunction.

Question semantics involves ∃ / ∨ (Hamblin 1973; Karttunen 1977):

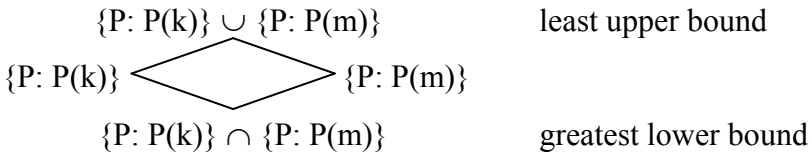
Who dances? {p: ∃x[human(x) & p = ^dance(x)] (& p is true) }
Does Kate dance? {p: p = ^dance(k) ∨ p = ^(¬dance(k)) (& p is true) }

The additive particles `also' and 'even' involve ∧:

Kate dances also, *Even Kate dances* entail that Kate dances **and** someone else dances.

Caveat: The finite universe and the naming constraints only pertain to paraphrasing quantification using propositional logic. Lattice theory (partial orders, algebraic semantics) does not impose such constraints. In those terms,

Kate or Mary denotes the least upper bound of the sets of properties that Kate has and Mary has
someone denotes the least upper bound of the sets of properties that the individuals in the universe have
Does Kate dance? denotes the least upper bound of the sets of sets-of-worlds in which Kate dances and in which Kate does not dance.
Likewise for *Kate and Mary, everyone, even Kate*, etc. and greatest lower bounds.



ka is a least upper bound operator (= disjunction, union, join)
mo is a greatest lower bound operator (= conjunction, intersection, meet)

3.1.2 Another unifying option: the semantics of alternatives and issue-raising

(Hamblin 1973; Rooth 1985; Kratzer & Shimoyama 2002; Mascarenhas 2009; Groenendijk & Roelofsen 2009; http://sites.google.com/site/inquisitivesemantics/Home)

All expressions denote sets of alternatives. *John* and *sleep* denote singleton sets of alternatives. In contrast, question words/indeterminate pronouns (*who/one*) and disjunctions (*or*) introduce genuine, i.e. non-singleton sets of alternatives.
Existential closure applied to sentences containing these asserts that one of the alternatives is true. Without existential closure they raise the issue of which alternative might be true.
The core semantics of questions is the same as that of disjunctions: introduces a number of alternatives (its possible answers) and requires that one of them be chosen.

The Inquisitive Semantics perspective unifies members of the **ka**-family in a new way: they operate on issues.
It is an open question whether a parallel unification can be found for members of the **mo**-family (maybe one related to free choice?).

3.2 Restricted universal quantification

3.2.1 ... in Malayalam (Jayaseelan 2011)

[56] a. oor-oo kuTTi-(y)um `every child'
one-DISJ child-CONJ
b. *oru kuTTi-(y)oo-(w)um
c. *oru kuTTi-(y)um-oo

[57] a. oor-oo kuTTi-(y)uDe oor-oo rakSitaaw-inte oor-oo paraati-(y)um
one-DISJ child-GEN one-DISJ parent-GEN one-DISJ complaint-CONJ
'each child's each parent's each complaint'

b. oor-oo kuTTi-(y)uDe-(y)um oor-oo rakSitaaw-inte-(y)um oor-oo paraati-(y)um
one-DISJ child-GEN-CONJ one-DISJ parent-GEN-CONJ one-DISJ complnt-CONJ

"In a distributive universal quantifier like *oor-oo kuTTi-(y)um*... What we get as a result is a partition of the class of 'child', such that each cell of the partition has just one member. The *-oo* forms the cells of the partition, and *-um* collects the disjuncts together and gives us a universal quantifier." (Jayaseelan 2011:281)

Jayaseelan's procedure a bit re-formalized (IOT is Partee's type shifter that retrieves the unique element of a singleton set):

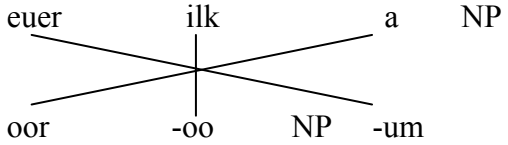
oo(one child) = {{child1}, {child2}, {child3}}
um(**oo**(one child)) = {P: P(IOT{child1})} ∩ {P: P(IOT{child2})} ∩ {P: P(IOT{child3})}
= the set of properties every child has

3.2.2 ... in (Middle/Early Modern) English (Jayaseelan 2011)

Jayaseelan argues that historically, *every = ever each;* and that it was often followed by the numeral *one* or its weakened form *a(n)*. From the Oxford English Dictionary entry for *every*:

a1300 Cursor M. 510 (Gött.) Iornays . . . fourti mile euerilk a day.
c1325 Pol. Songs (1839) 157 Everuch a parosshe heo polketh in pyne.
1352 MINOT Poems x. 51 God save sir Edward his right In everilka nede.
c1440 HYLTON Scala Perf. (W. de W. 1494) II. xli,
Eueryche a soule resonable owyth for to coueyte . . . nyghynge to Jhesu.
1558 Q. KENNEDY *Compend. Tract. in Wodr. Soc. Misc.* (1844)
117 Bot everilk faithfull minister to bestowe the grace quhilk God hes gevin hym.

Jayaseelan proposes that *each* is disjunction (a polarity existential), *ever* is conjunction, and so *euerilk a day* is built in exactly the same way as Malayalam restricted distributive quantifiers.



4. Questions

Big questions:

(A) To what extent should compositionality extend below the word level in the broadly speaking quantificational domain (comparatives, polarity items, exceptives, etc. included)?

(B) If sub-word compositionality is the norm, to what extent do we expect cross-linguistic isomorphy in logical words? Witness the following, semantically similar/identical but etymologically/morphologically dissimilar operators:

English *almost*, Russian *pochti*, French *presque*, Hungarian *majd(hogy)(nem), ...*

Smaller-scale, methodological questions:

(a) It is sometimes proposed that not all uses of one superficial morpheme represent the same lexical item; e.g. Shimoyama (2006) argues, based on the absence of intervention effects, that *mo* 'every' and *mo* 'also'are distinct. Do these *mo*'s then share a semantic core and differ in what some phonetically null material contributes, or are they truly independent, and their identical shapes a historical accident?

(b) Not all languages possess as elaborate an inventory of *ka/mo* type items as Japanese. Is there a principled explanation for the gaps (or, can they at least be thought of as normal products of language change)?

(c) There is significant cross-linguistic variation in what stretches of the sentence such morphemes operate on; see Kratzer & Shimoyama (2002), Zimmermann (2009) a.o. Is this variation compatible with a unified semantics?

(d) If Jayaseelan's conjecture about English is correct, then the morphological matches sometimes break down: *ever* may be a conjunction (greatest lower bound) operator, but its shape does not bring *and* to mind; see also the Hungarian data. What do we make of this?

(e) Recognizing *ever* as a component of *every* is not too controversial, but is it legitimate to treat *-y* as a representative of *each*? Where should the line be drawn between diachronic and synchronic analysis? How suggestive is the Malayalam data of the analysis of English? How strong is the English-internal motivation?

(f) The Malayalam construction in [56] works only with the numeral 'one'; with higher cardinalities Malayalam uses plain sorting-key reduplication without *–oo* or *–um*: *mu-mmuunnə kuTTikaL* `two-two children' for `every two children' (though based on Balusu 2005 I doubt J's analysis of reduplication). It is an interesting question whether the reduplicative construction in Malayalam creates a blocking effect, or the divergence is semantically significant. Suppose the blocking effect analysis is correct; how should compositional semantics deal with blocking effects?

I am sure there are more questions to ask...

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