CHAPTER 8

WHY ARE COMPOUNDS A PART OF HUMAN LANGUAGE? A VIEW FROM ASYMMETRY THEORY

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Compounds are a part of human language. They may include functional elements, such as case markers and prepositions, as well as phrases, and the order of their constituents, while being rigid within a given language, differs cross-linguistically, as the examples in (1) illustrate. Notwithstanding their diversity, compounds share some basic properties. They include more than one constituent. They are opaque syntactic domains. Their semantics is not necessarily compositional, and their stress pattern does not generally coincide with those of words or phrases.

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(1) a. spell-checker
paper bag
redneck

b. *homme-de-paille* (French)
man-of-straw
'strawman'

c. *aam khaanaa acchaa lagtaa hai*
mango eat-INF good seems is
'It feels good to eat mangoes.' (Hindi)

d. *awoko-busi* (Yoruba)
driver-bus
'bus driver'

e. *pijen-o-erx(ome)* (MG)
come-LV-go
'come (and) go'

f. *bou-dati* (Japanese)
stick-stand
'stand straight'

Recent developments in evolutionary psychology (Hauser, Barner, and O'Donnell 2007) indicate that compounds are not a part of the language of non-human primates, and a natural question that comes to mind is why they are a part of human language.

According to Hauser, Chomsky, and Fitch (2002), recursivity is a distinctive aspect of the language faculty (i.e. the biological basis of language). The language faculty must be the generative engine enabling the production and the comprehension of compounds, since recursivity can be observed in compounds. Furthermore, new compounds can be coined in any language. Children produce these forms quite early, around age 2 or 3 (see Clark and Barron 1988, Hiramatsu et al. 2000, Nicoladis 2007), sometimes with meanings that they are unlikely to have heard before, and always without any formal instruction. The identification of the operations generating these constructs will contribute to our knowledge of the language faculty. Compounds also have properties that differentiate them from phrases and sentences, and the identification of these properties will contribute to our understanding of how the language engine operates within the overall architecture of the language faculty. Compounds also have interface properties that make them interpretable by the external systems. Special cues accessible to the sensorimotor system (SM) contribute to making compounds tractable by humans, even though their structure may include unpronounced constituents accessible only to the human conceptual-intentional (CI) system, as discussed in this chapter. The identification of these overt and covert cues will contribute to our understanding of the contact between linguistic expressions and the external systems.

This chapter raises the following theoretical questions:

- Why are compounds a part of human language?
- How do their properties follow from the human computational system (C_{HL})?
- How do they satisfy the interface legibility conditions?

I address these questions from the viewpoint of Asymmetry Theory (Di Sciullo 2003a, b, 2005a, and related works). I argue that compounds are a part of human language because they are derived by the operations of C_{HL} while they satisfy the interface interpretability condition in ways that phrases and sentences do not.

Their properties, including strict linear precedence relations, strict scope, and opacity, follow from the C_{HL} without requiring additional operations or conditions besides those that are needed independently for the derivation of other sorts of linguistic expressions.

I focus on the properties of English compounds, which I take to be derived in the morphological workspace (D_M) of the grammar, and follow Di Sciullo (2005b) in taking French compounds to be derived in the syntactic workspace (D_S) of the grammar, and transferred to D_M. Both sorts of derivations generate domains of asymmetric relations (phases), and they differ with respect to the preservation of asymmetry. Given Asymmetry Theory, compounds have a unifying property, namely, they include a functional projection asymmetrically relating their parts. The simplified representations in (2) capture the unity and the differences in the linear order of the constituents of these constructs.

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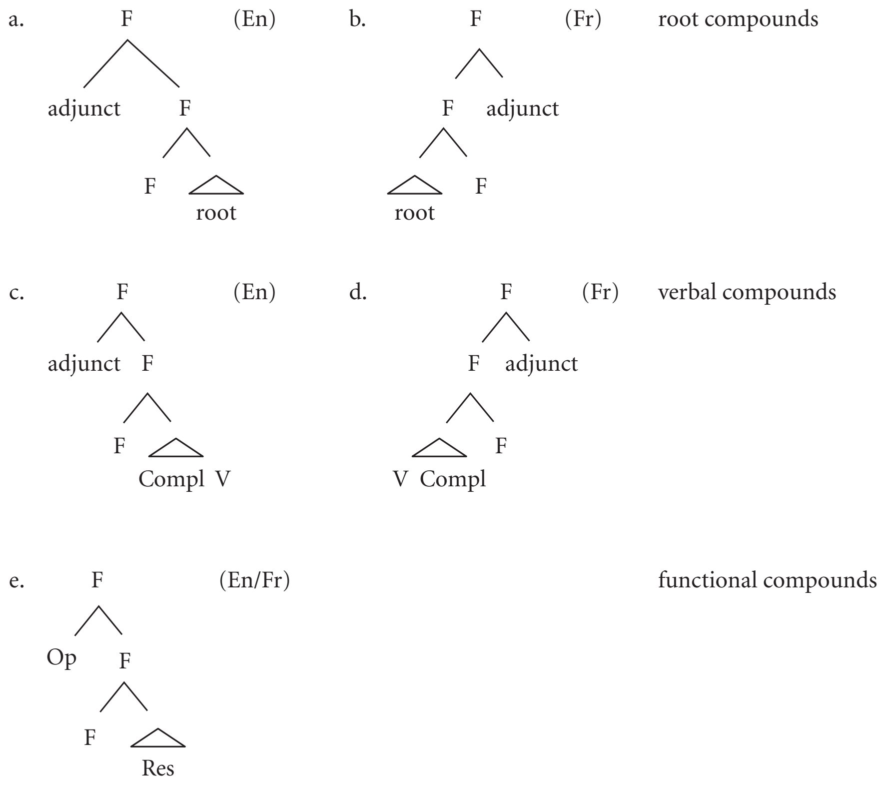

Compounds are domains of the computation, the locus of independently motivated (uninterpretable) active feature-checking. Like the syntactic domains, they are subject to the Interpretability Condition (Full Interpretation) requiring that only interpretable elements survive at the interfaces.

In Asymmetry Theory, compounds are derived in the morphological workspace by the recursive operations of the morphology (Di Sciullo 2005a, b; Di Sciullo and

Landman 2007; Di Sciullo and Tomioka 2007; Di Sciullo and Banksira, in press). The lexicon has no generative role in this model, as is the case in Chomsky (1970), and Di Sciullo and Williams (1987). The lexicon is a repertoire of items, including affixes, stems, roots, compounds, and idioms, with their underivable properties, which must be learned. Asymmetry Theory shares properties with the lexicalist approach to compounds (see Levin and Rappaport Hovav 1999, Lieber 2004), where fine-grained descriptions of affixes and roots are provided (see Di Sciullo 1992b, 2007a). It also shares properties with Distributed Morphology (Halle and Marantz 1993; Marantz 1997, 2000, and related works), which offers a more constrained approach to derivation and compounding. Borer (2003, 2005) proposes an intermediate view where argument structure is either determined by the computation or specified in a minimalist lexicon. Limits of the lexicalist and the distributed approaches are discussed in Borer (2003, 2005a, b), and in Reinhart and Siloni (2005). If compounds were purely lexical-semantic objects, I would not expect compound-internal object/adjunct asymmetries to be observed, contrary to facts. If compounds were pure syntactic objects, I would not expect syntactic opacity to be observed cross-linguistically; neither would it be possible to account for their morphological compositionality, as discussed in section 8.3. Given Asymmetry Theory, the restrictions on the derivation of English compounds follow from the application of the operations of the grammar in different workspaces.

The organization of this chapter is as follows. First, I discuss the asymmetries observed in the domain of English compounds and relate them to the ones observed in the domain of affixed forms. Second, I show how compounds are derived in Asymmetry Theory. Finally, I consider how they satisfy the *Interface Interpretability Condition* and bring to the fore recent experimental results on compound processing.

8.1 Asymmetry

According to Asymmetry Theory (AT), asymmetric (i.e. directional) relations are the core relations of the language faculty.[1] Asymmetry is hard-coded in the morphology, since the configurational primitive of D_M is the minimal tree, that

[1] Asymmetry, as a formal property of the relations derived by the grammar, has been discussed in various works. It has been shown to be a property of syntactic relations (Reinhart 1983, Kayne 1994, Moro 2000, Chomsky 2000), phonological relations (Raimy 2000, van der Hulst and Ritter 2003), and morphological relations (Roeper 1999; Hale and Keyser 2002; Di Sciullo 2003a, b, 2005a). See Di Sciullo (2003a, b) for discussion.

is, a tree with only one complement and only one specifier, with the hierarchical structure in (3). The operations of D_M apply to minimal trees, the elements of which cannot be extracted in the course of the morphological derivation.[2]

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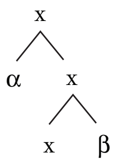

If English compounds are derived in D_M, asymmetries that are not typical of phrases and sentences are expected to be observed in compounds. This is effectively the case, as further evidenced below, and is an instance of the *Strict Asymmetry of Morphology.*

(4) Strict Asymmetry of Morphology
Asymmetry is the characteristic property of morphological relations.

According to AT, there is a basic property of relations that differentiates morphological from syntactic derivations: morphological relations are strictly asymmetrical. In other words, morphology is blind to symmetrical, bidirectional relations. This is not the case for syntactic derivations if Moro (2000) is correct in assuming that points of symmetry can be generated in the course of a syntactic derivation, for instance in the case of the derivation of copular and inverse copular constructions. According to Dynamic Antisymmetry, movement must destroy the points of symmetry by moving one or the other constituent in a symmetrical relation, e.g. *the reason for his success is his great determination*, *his great determination is the reason for his success.* Interestingly, points of symmetry are never created in morphological derivations. If it were the case, similar situations would be expected in syntactic derivations, contrary to facts. As evidenced in Di Sciullo (2005a), on the basis of the ordering of affixes with respect to roots, morphological derivations are strikingly distinct from syntactic derivations. The fact that the parts of a morphological expression cannot be inversed (5) without giving a difference in semantic interpretation (6) provides evidence that morphological relations are asymmetric only. This also holds for compounds, such as the ones in (7), where those in (7b) are excluded, and those in (7c) have a different interpretation from (7a), provided that there is a world of interpretation where they can be interpreted.

(5) a. bio-logic-al
b. *bio-al-logic, *al-bio-logic, *logic-bio-al, *logic-al-bio, *al-logic-bio

[2] The minimal tree is a primitive of D_M; it is not a primitive of D_S, since the operations of D_S may apply to objects which do not have an internal structure, as is the case for Chomsky's (2001) definition of Merge.

(6) a. *enlight* (tr.) to illumine, to enlighten (archaic)
b. *lighten* (intr.) to become lighter; brighten, to be luminous; shine, to give off flashes of lightning

(7) a. human primate, non human primate
b. *human primate non, *primate human non, *non primate human
c. #primate non human, ##human non primate

Furthermore, the fact that no scope ambiguity is observed in morphological objects including two scope-taking affixes provides additional evidence that morphological relations are asymmetrical only. For example, *undeniable* includes negation, spelled out as the affix *un-*, and a modal, spelled out by the affix *-able*, and negation scopes over the modal, but the inverse scope interpretation, where the modal scopes over the negation, is not available. Thus if *x is undeniable*, then *it is not possible to deny x*, and it is not the case that *it is possible not to deny x*. Likewise, scope ambiguity is not observed in compounds including scope-taking elements, such as quantifiers, which brings further support to the asymmetry of morphological relations. Thus, if *x saw no one*, then *x saw nobody*, and it is not the case that *there is somebody that x did not see*. See Di Sciullo (2005a) for discussion.

Compounds are formed of strictly asymmetric relations.[3] This is evidenced by the fact that the constituents of a compound cannot be reordered without giving rise to morphological gibberish or to a difference in interpretation, as further illustrated in (8)–(9).[4,5] Different orders, if interpretable in a given world, yield different interpretations, which indicates that compounds with the inverse order of constituents are not derivationally related.

(8) a. a huge [hard disk] /*a huge [disk hard]
b. a [football] team /* a [ballfoot] team
c. a [four-star] hotel /* a [star-four] hotel

(9) a. a big [paper bag] /≠ a big [bag paper]
b. a [blue-grey] sky /≠ a [grey blue] sky
c. a spectacular [hit-and-run] /≠ a spectacular [run and hit]

[3] Asymmetric relations are directional. Thus, if A precedes B, then B does not precede A. If A dominates B, then B does not dominate A. If A asymmetrically c-commands B, then B does not asymmetrically c-command A. Asymmetric relations have been shown to play a central role through the derivations and the interfaces between the grammar and the external systems. Binding relations between pronouns and their antecedents have also been couched in terms of the asymmetric c-command relation (see Chomsky 1981, and related works). Conditions on extraction from embedded contexts (islands) have also been widely discussed since Ross's (1968) seminal work.

[4] Compounds are asymmetrical in terms of formal properties of relations (precedence dominance, asymmetrical c-command), as defined in note 3.

[5] Our point differs from Bisetto and Scalise's claim (in this volume) that some compounds, e.g. *producer-director*, *blue-green*, *pass-fail*, *mother-child (relations)* are symmetrical with respect to their lexical semantic interpretation. For example, a *producer-director* is someone who is both a producer and a director. However, there is little empirical evidence for treating conjunction in natural languages as a symmetrical relation.

Given Asymmetry Theory, the recursive operation of the grammar applying in the morphological workspace combines structures with inherently asymmetric properties. Furthermore, the parts of a compound cannot be reordered in the course of its derivation to the SM interface because in AT, there is no rule that displaces the parts of morphological constituents. Given the recursive operation that combines minimal trees, it follows that asymmetric c-command holds between the parts of a compound. In Kayne's (1994) Antisymmetry framework, this would be a consequence of the Linear Correspondence Axiom, according to which the precedence relation between the terminal elements of a linguistic expression is a function of the asymmetric c-command between the pre-terminal elements of this expression. Thus, the structural relations in compounds cannot be reduced to sisterhood, even though most compounds include two pronounced constituents only.

8.1.1 The medial F-tree

Di Sciullo (2005b) provided empirical evidence for the hypothesis in (10) according to which functional (F) projections asymmetrically relate the parts of compounds.

(10) F-TREE HYPOTHESIS
All compounds include an F-tree.

The F-tree is an instance of the minimal tree, which is a primitive of the D_M, and finds its root in the basic asymmetry of morphological relations. The other constituents of a compound may take the whole F-tree as a complement, or may be located in the complement of the F-tree. The head of the functional projection may be legible at the phonetic interface, whereas it is necessarily legible at the semantic interface.

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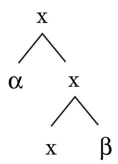
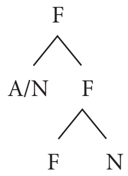


A first argument in favour of this hypothesis comes from the fact that a root compound (12) instantiates a modification relation, which by standard assumptions maps onto a functional relation (see Cinque 1999, Carlson 2003). Thus, the first constituent of a root compound in English, whether an adjective (A) or a noun (N), occupies the specifier of an F-tree; the second constituent is located in the complement position of the F-tree (13).

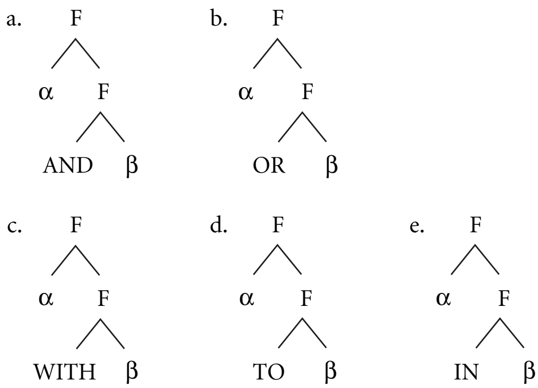
(12) a. floppy disk, pink orange, dark villain
b. rubber band, ash tray, golf ball, kitchen towel
c. jet black, ruby red, lily white, steel blue, powder blue

(13)


A second argument in favour of the F-tree hypothesis is that a functional head must be part of the structure of compounds for interface interpretability considerations. Functional heads are part of the closed set of functional elements. Thus, a connective must be SM-legible in compounds such as the ones in (14a), which are not well formed otherwise (14b). Given that a pronounced F-head is part of (14a), an unpronounced F-head is required for the interpretation of compounds such as the ones in (14c). Other unpronounced functional heads than AND and OR may fill the F-head, including WITH (15 a), TO (15b), and IN (15c). Thus, we have the F-heads in (16).

(14) a. bed-and-breakfast, hit-and-run, truth-or-dare
b. *bed-breakfast, *hit-run, *truth-dare
c. learner-driver, student-worker, assistant-teacher

(15) a. martini soda, gin (and) tonic, vodka soda
b. Montreal-Boston train, New York-Dubai flight
c. Paris, Texas; Venice, California; Tucson, Arizona

(16)


Since there is no modification relation between the members of these compounds, the specifier position of the F-tree cannot be the locus of one of the constituents of the compounds. The only option available is that the first constituent takes the F-tree as its complement and the second constituent occupies the complement position of the F-tree. The F-tree is required at the semantic interface for interpretation. Conjunctions, disjunctions, and prepositions are F-heads providing the semantic relations between the constituents of compounds, whether they are legible at SM (e.g. *hit-and-run*, *truth-or-dare*, *martini-with-soda*) or not (e.g. *a win-win situation*, *a mother-child conversation*, *martini-soda*). The presence of unpronounced F-heads in compounds brings further support to the analysis of these constructs in terms of asymmetric relations.[6] The F-head bears the semantic features relating the parts of compounds whether or not the F-head is legible at the SM interface.

A third argument for the F-tree hypothesis is that it is also required for SM interpretation. The linking vowel (LV) -*o*- is found in English and in Romance languages (17–18) in a restricted set of compounds where the first member is a stem. In Modern Greek (MG), LVs are generalized in compounds, provided that there is the proper morphophonological context (19). Compounds with medial LVs are found in many languages, including those in the Hellenic, Germanic, Romance, and Slavic families, as illustrated in (20) with Polish and Russian.

(17) lexic**o**-semantic, syntactic**o**-pragmatic, Jude**o**-Spanish pronunciation

(18) ital**o**-américain, judé**o**-chrétien, sad**o**-masochiste (Fr)
'Italo-American', Judaeo-christian', 'sadomasochist'

(19) a. *pag**o**vuno* (MG)
pag-**o**-vun-o
ice-LV-mountain-NEUT.NOM.SG
'ice-berg'

b. *kapn**o**kalierjia*
kapn-**o**-kalierg-i-a
tobacco-LV-cultivat(e)-ion-FEM. NOM.SG
'tobacco cultivation'

c. *aspr**o**mavro*
aspr-o-mavr-o
white-LV-black-NEUT.NOM.SG
'white and black'

(20) a. *cheb**o**opiekacz* (Polish)
cheb-o-opiek-acz
bread-LV-toast-er.NOM
'toaster'

b. *vinodelie* (Russian)
vin-o-delie
wine-LV-making
'wine producing'

According to the F-tree hypothesis, an F-head is part of the morphological structure before it is transferred to the phonology workspace (D_Φ). Thus no additional morphophonological operation for the insertion of a linking vowel is

[6] See Munn (1992), Thiersch (1993), and Kayne (1994) for discussion on the asymmetric properties of coordination structures. See Sportiche (1999) and Kayne (2004) for the analysis of prepositions as categories generated in the functional field.

needed. The F-head is spelled out by the LV. While the presence of the LV is constrained by the morphophonology, its position in D_Φ is provided by the F-tree, which is transferred from D_M to D_Φ.

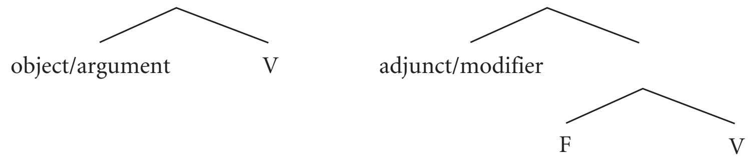
Thus, the motivation for the medial F-tree hypothesis is threefold. First, a compound with a modification relation includes the F-tree, since modifiers occupy the specifier of functional projections. Second, the F-tree must be a part of compounds for semantic interface legibility. Third, it must also be a part of compounds for phonetic interface legibility. Since it must be legible at the CI interface, the F-tree is a part of the derivation of compounds even in the cases where it is not legible at the SM interface.

8.1.2 Configurational asymmetries

Configurational asymmetries are observed in compounds. This is predicted by AT, since according to this theory, asymmetric relations are the core relations of morphology.

Given the architecture of AT, morphological and syntactic derivations share the generic properties of the grammar and differ with respect to the instantiation of these properties. Morphology and syntax share the object/adjunct (internal argument/modifier) asymmetry, which maps onto a hierarchical structure where an adjunct (modifier) is higher in the functional projection than the logical object (internal argument), as minimally represented in (21).[7]

(21) a. b.



As seen in the previous section, the derivation of compounds includes an F-tree contributing to compound-internal asymmetry. One consequence of the minimal F-tree is that it derives the configurational basis of the object/adjunct asymmetry.

The asymmetry between objects and adjuncts has received much attention in works on compound formation (e.g. Baker 1988, Rosen 1989, Rivero 1992, Spencer 1995, Kuiper 1999). A major puzzle concerning compounds is that even though

[7] It is generally assumed that modifiers are generated in the extended projection of a head. Thus, they sister-contain the element they modify. The difference between internal arguments and modifiers is a major consideration in syntactic theories that follow Montague's insight of strict compositionality (Montague 1973). Modifiers exhibit different patterns of combinatorial properties from arguments such as objects both in syntax and semantics (see Davidson 1967, Higginbotham 1985, Heim and Kratzer 1998, Cinque 1999). One of the consequences of these studies is the general consensus that syntactic modifiers and arguments must be represented in structurally distinct manners.

Head-movement captures the compound formation of object-verb type (Baker 1988), it cannot account for the presence of adjunct-verb compounds. The derivation of compounds, be they object-verb or adjunct-verb compounds, follows from the application of the operations of AT, as discussed in section 8.2.

English verbal compounds provide direct empirical evidence of the object/adjunct compound-internal asymmetry. In English verbal compounds, the dependent of the verb is either its logical object (22a) or an adjunct (22b) or both (22c). Interestingly, in the latter case, the adjunct must precede the object, cf. (22d).

(22) a. blood testing
b. clinical testing
c. clinical blood testing
d. *blood clinical testing

Here again, in AT the strict ordering of the constituents of a compound follows from the properties of the operations of the grammar, which apply under asymmetric Agree, as defined in section 8.2. Consequently, modifiers are generated higher than the predicates and their arguments. Given that there is no displacement operation in D_M, asymmetries in dominance relations, such as the one illustrated in (23), are preserved through the derivations.[8]

(23) $[_F$ clinical F $[_N$ blood testing]]

Assuming, as Chomsky does (various works from 1995 on), that subjects (external arguments) are not adjuncts (contra Kayne 1994), the fact that subjects do not generally merge with verbs in the derivation of compounds brings additional support to the view that the object/adjunct asymmetry, and not another sort of asymmetry, such as the syntactic complement/non-complement asymmetry (Huang 1982; Rizzi 1980; Chomsky 1981, 1995a, 2001), is the crucial asymmetry in the derivation of compounds.

Interestingly, finer-grained linear precedence asymmetries between different sorts of adjuncts are observed in English compounds, suggesting further that asymmetric relations are hard-wired in morphology. The examples in (24) show that an agentive adjunct must follow a spatial-locational adjunct. The examples in (25) illustrate that a sequential/temporal modifier must precede a spatial-locational modifier. Thus we have the morphological configurations in (26). Syntactic adjuncts do not show the restrictions on linear precedence relations observed in compounds: compare (24)–(25) to (27). This also indicates that morphological asymmetries cannot be equated to syntactic asymmetries.

[8] Syntactic complement/non-complement asymmetries have been extensively discussed in the literature (Huang 1982, Chomsky 1981, Rizzi 1990, Chomsky 1995a), and different conditions have been proposed to account for the fact that in embedded contexts extractions from complements are more natural than extractions from adjuncts. The complement/non-complement asymmetry cannot be attested on the basis of extraction, since compounds are morphological expressions, and thus, their constituents are not subject to internal Merge (movement), as discussed in Di Sciullo (2005a).

(24) a. expert-tested drug
b. hospital-expert-tested drug
c. *expert-hospital-tested drug

(25) a. hospital expert tested drug
b. bi-annual hospital expert tested drug.
c. *hospital bi-annual expert tested drug

(26) a. [$_F$ hospital F [$_F$ expert F [$_A$ tested]]]
b. [$_F$ bi-annual F [$_F$ hospital F [$_F$ expert F [$_A$ tested]]]]

(27) a. This drug has been tested by experts in a hospital.
b. This drug has been tested in a hospital by experts.
c. Since 1984, this drug has been tested by experts in a hospital twice a year.
d. Since 1984, this drug has been tested by experts twice a year in a hospital.

Furthermore, the fact that the direct object, but not the indirect object, may be part of a verbal compound (28) also follows from the theory without further stipulations, such as the First Sister Principle (Roeper and Siegel 1978). If we assume that functional heads including prepositions are generated outside of the verbal projection V (Kayne 2001, Sportiche 1999), and that they are generated higher than the verbal projection, it follows that the indirect object of such verbs cannot be part of a compound. Thus, we have:

(28) a. assignment giving (to students) /*student giving (of assignments)
b. letter sending (to relatives) /*relative sending (of letters)
c. book arranging (on shelves) /*shelf arranging (of books)

Given that the recursive operations of the grammar apply under asymmetric Agree, as defined below in (51), to two minimal trees, it follows that a verb may only combine with its direct object. In effect, only the features of the direct object are properly included in the features of the verb, and the indirect object may only combine with a preposition, which is indirectly related to the verb.

Thus, the restrictions on linear precedence and dominance relations between the parts of compounds are predicted by AT, according to which morphological relations are strictly asymmetric.

8.1.3 Compounding and derivation

The asymmetries observed in English compounds correlate with the asymmetries observed in derivational morphology.

According to the morphological types of affixes defined in Di Sciullo (2005a, c), affixes distribute in three morphological types, operator affixes, modifier affixes, and predicate affixes (29). Operator affixes, both internal-bound and external-bound, scope over the other types of affixes, and modifier affixes scope over (sister-containing) predicate affixes, as expressed in the hierarchy in (30). A sample of the affix types is provided in (31)–(33).

(29) Typology of affixes

Affix type	Determines	Subtypes	
Predicate affix	argument structure	primary	secondary
Modifier affix	aspectual modification	external	internal
Operator affix	operator-variable binding	internal-bound (specifier)	external-bound (head)

(30) $[_{Op}\text{Op-af}\ [_{Op}\ \text{Opx}\ [_{Mod}\ \text{Mod}\ [_{Mod}\ \text{F}\ [_{Pred}\ \text{Spec}\ [_{Pred}\ \text{Pred-af}]]]]]]$

(31) Sample of English predicate affixes

	AFFIX TYPE	RATE OF		EXAMPLES
a.	PRIMARY	Lower-order predicates	N	*-er (writer), -ee (advisee), -ion (Production)*
			V	*-ize (vaporize), -ate (alienate), -ify (codify)*
b.	SECONDARY	Higher-order predicates	A	*-able (readable), ive (instructive)*
			A	*-ous (dangerous), -ic (symbolic), -al (accidental)*
			ADV	*-ly (happily)*

(32) Sample of English modifier affixes

	AFFIX TYPE	RATE OF	EXAMPLES
a.	POSITIONAL	N	*pre- (pre-university), post- (postgraduate), fore- (forecast), ex- (ex-cop), mid- (midnight)*
b.	DIRECTIONAL		*pro- (pro-rata), anti- (anti-body), counter- (counteroffer), self- (self-respect)*
c.	SEQUENTIAL	V	*re- (rewind), dis- (discharge), un- (unload)*
d.	SPATIAL		*en- (enthrone), a- (await)*
e.	NUMERAL	A	*semi- (semi-annual), bi- (bipolar), di- (disyllabic), tri- (tridimensional), quadri- (quadrilateral)*
f.	PRIVATIVE		*un- (unclear), non- (non-permanent), in- (incomprehensible), a- (asocial)*

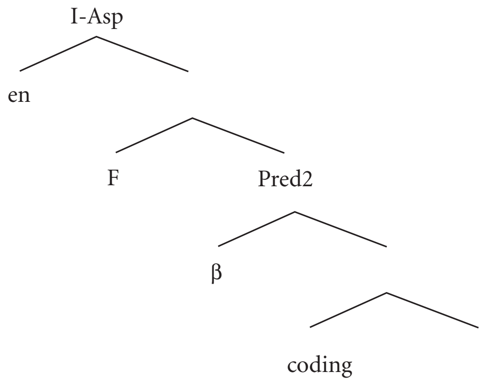
(33) SAMPLE OF ENGLISH OPERATOR AFFIXES

	AFFIX TYPE	POSITION	PART OF	EXAMPLES
a.	INTERNAL-BOUND	Specifier	D	*th*-words (*the*, *this*, *that*, *those*, . . .)
				wh-words (*who*, *what*, *where*, *when*, . . .)
				pronouns (*him*, *her*)
			C	*complementizers* (*th-at*)
b.	EXTERNAL-BOUND	Head	V	*-ed* (*washed*), *-s* (*drives*)
			N	*-s* (*cats*, *dogs*)
			A	*-most* (*leftmost*)

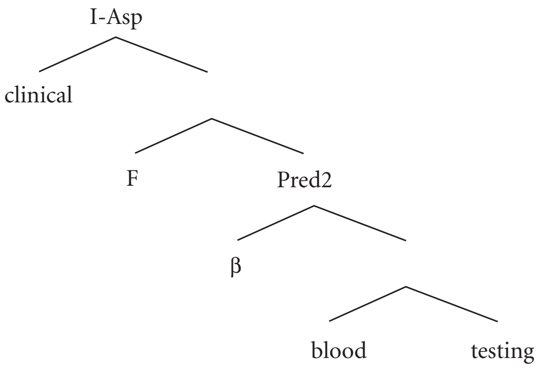
The configurational asymmetries observed in compounds pattern with the ones observed in affixed forms.

First, the argument/modifier asymmetry attested in compounds follows from the fact that elements in the domain of secondary predicates (adjectival and adverbial modification) asymmetrically c-command the elements in the domain of the primary predicates (primary predicates and their arguments). The facts in (22) illustrate that in a compound, a modifier must precede an argument.

(34)



(35)



Second, I have shown in Di Sciullo (1997, 1999, 2005a) that derivational affixes present asymmetries in dominance relations. In particular, affixes modifying the aspectual features of the verbal root to which they apply, such as spatial prefixes, are generated lower in the verbal projection tree than affixes modifying aspectual features, without affecting the argument structure of the verbal root, such as the sequential affixes.

French verbs including sequential (iterative and inverse) and spatial (directional and locational) prefixes present asymmetries in linear order, as schematized in (36a), recursivity (36b), and locality effects (36c). Taking af_1 to be external aspect affixes, and af_2 to be internal aspect affixes, the facts in (37)–(40) illustrate the asymmetries. E-prefix must precede I-prefix (37); E-prefix can be iterated, I-prefix cannot (38); I-prefix must be spelled out if E-affix is, when the root does not have I-Asp features (39); I-prefix affects the structure of the v, E-prefix does not (40).

(36) a. $af_1 > af_2 >$ root /*$af_2 > af_1 >$ root
b. $af_1^n > af_2 >$ root /* $af_1 > af_2^n >$ root
c. $af_1 > af_2 >$ root /* $af_1 > af_2 >$ root

(37) a. *Julie a réemporté/*enréporté les livres.* (Fr)
'Julie brought the books back again.'

b. *Lucie a réenfermé/*enrefermé le chat dans la cave.*
'Lucie locked the cat in the basement again.'

(38) a. *Marie a rerefait / redéfait le puzzle.*
'Mary redid/undid the puzzle again.'

b. **Jane a aa/enemporté/aem/emapporté les livres à Paul.*
'Jane brought the books to Paul.'

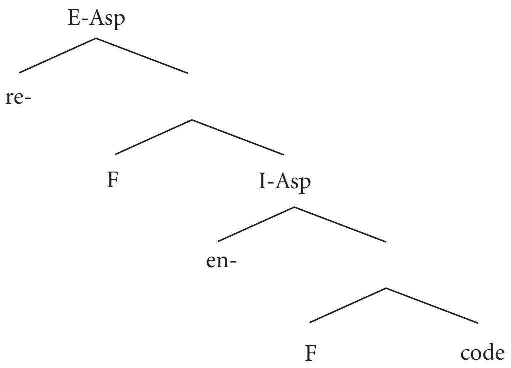
(39) a. *Il a réembouteillé/*rebouteillé le vin.*
'He rebottled the wine.'

b. *Il a réembarqué/*rebarqué sur le bateau.*
'He embarked on the boat again.'

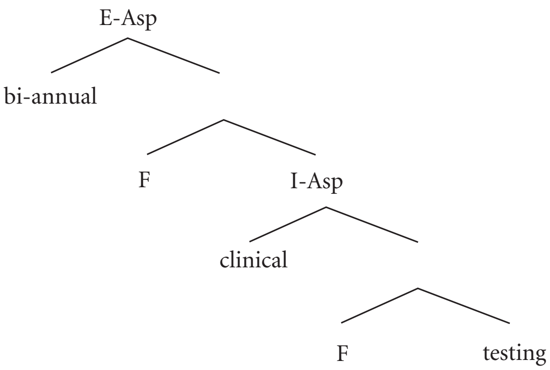
(40) a. *Il a (re)dormi pendant des heures.*
'He slept again for hours.'
b. *Il a (r)endormi Jean immédiatement.*
'He made Jean sleep again immediately.'

Given Asymmetry Theory, E-Asp asymmetrically c-commands I-Asp affixes in the aspectual modification domain (41), and the asymmetry illustrated in (25) follows without requiring movement (42).

(41)



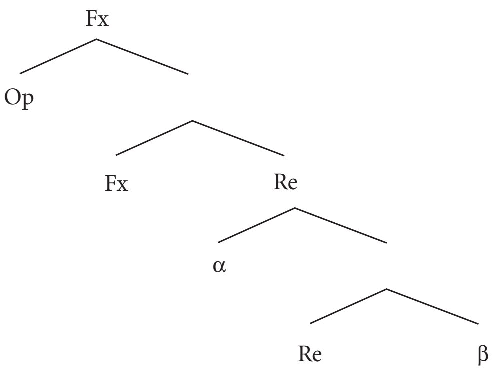
(42)



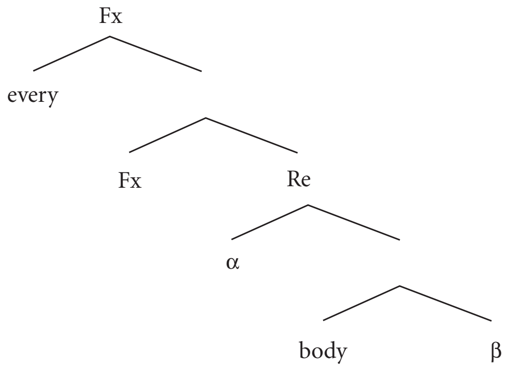
If compounding and derivation in English share basic architectural properties of the language faculty, we expect asymmetries to be found in compounds. The examples above, where the sequential modifier must precede the spatial modifier, show that this prediction is also borne out.

Third, we correctly predict that compounds including elements with operator features are a part of natural languages. Quantifiers such as *somebody* and *everybody* provide the empirical content for this prediction. They are bipartite constituents. They include a functional head, a quantifier, and a complement of the head, namely, a restrictor to the variable internally bound by the quantifier (operator):

(43)



(44)



Quantifier structures are impenetrable: their parts cannot be separated by other material, including adjectives. This is not the case for their phrasal counterparts, as illustrated in (45) and (46). Furthermore, their parts cannot be separated by other material, including adjectives, whereas this is not so for DPs. Furthermore, their semantic interpretation is the result of the composition of a small set of semantic features, including [+human] and [+thing]. Thus, in (47), *someone* may only refer to a set of humans, whereas this is not the case for the syntactic counterpart in (48), which can refer to a set of humans as well as to a set of things. See Di Sciullo and Landman (2007) for discussion.

(45) a. [Everybody] left.
b. [Everybody] nice left.
c. *[Every nice body] left.

(46) a. [Every student] left.
b. *[Every student] nice left.
c. Every [nice student] left.

(47) a. I saw someone.
b. He discovered someone nice.
c. Here is somebody important.

(48) a. I saw some nice ones.
b. He discovered some nice ones.
c. Here is some important (body of) work.

To summarize, in this section I have provided additional evidence that compounds are domains where strict asymmetric relations hold. In the next section, I provide the derivation of compounds, given the operations of Asymmetry Theory.

8.2 Deriving compounds with Asymmetry Theory

8.2.1 The operations of D_M

Asymmetry Theory extends the Derivation-by-Phase model (Chomsky 2001, 2004) to a fully parallel model, where the derivation of linguistic expressions takes place in parallel workspaces, each one being an instantiation of the generic properties of the grammar.[9]

Deriving compounds in a different workspace from phrases provides an architectural account for the fact that these expressions have different derivational properties, as well as different interface properties, including linear order, stress assignment, and compositionality. For example, in English, the Nuclear Stress Rule (Chomsky and Halle 1968) places main stress on the rightmost constituent of a syntactic phrase, whereas the Compound Stress Rule stresses the left member of a compound. Compounds also generally exhibit opacity with respect to syntactic and semantic operations, as discussed in various works including Di Sciullo and Williams (1987), Di Sciullo (1992b, 2005a). Their parts cannot be questioned or passivized, and the antecedent of a pronominal anaphor cannot be a nominal element included in a compound.[10]

The operations of D_M, (49) and (50), apply to minimal trees under Agree (51) and recursively derive morphological domains legible at the interfaces. The operations of D_Φ, including (52), derive morphophonological domains legible at the SM interface. The morpho-semantic properties of morphological objects are legible at the CI interface, whereas their morphophonological properties are legible at the SM interface.

(49) M-Shift (T_1, T_2): Given two trees T_1 and T_2, M-Shift (T_1, T_2) is the tree obtained by attaching T_2 to the complement of T_1.

[9] The generic properties include the distinction between interpretable and uninterpretable features, and a set of generic operations, applying under Agree (46), as well as an Interface Interpretability Condition requiring that only interpretable elements in an asymmetric relation are legible at the interfaces. The generic operations are the following:

(i) Shift (α, β): Given two objects α and β, Shift (α, β) derives a new object δ projected from α.
(ii) Link (α, β): Given two objects α and β, α sister-containing β, Link (α, β) derives the object (α, β), where α and β are featurally related.
(iii) Flip (*T*): Given α Minimal tree α in D_1, Flip (*T*) derives a mirror image of α at PF.

The operation in (i) is the generic form of the essential operation of recursive systems. This operation is asymmetric since only one object may project its label. The operation in (ii) is the generic operation deriving dependencies between features. This operation is directional, thus asymmetric, contrary to the coindexing operation, which is bidirectional (see Higginbotham 1985 on the directional properties of dependencies). The operation in (iii) contributes to the linearization of the constituents and applies in the phonological workspace D_Φ. Independent evidence in favour of this operation is provided in Williams (1994) and in Wurmbrand (2003b). The operations in (i)–(iii) have different instantiations in D_S and D_M.

[10] See also Kastovsky (1981) and Lieber (1992a) on anaphoric islands.

(50) M-Link (T): Given a tree T containing a position δ1 and a position δ2, such that δ1 sister-contains δ2 and δ1 agrees with δ2, M-Link (T) is the tree obtained by creating a featural relation between δ1 and δ2.

(51) Agree (φ1, φ2): Given two sets of features φ1 and φ2, Agree holds between φ1 and φ2, iff φ1 properly includes φ2.

(52) M-Flip (T): Given a minimal tree T such that the Spec of T has no PF features, M-Flip (T) is the tree obtained by creating the mirror image of T.

Given Asymmetry Theory, the morphological scope relations are derived in D_M and are legible at the CI interface. The ordering of the morphological constituents is derived in D_Φ by the operation in (52). This operation derives the effect of Head movement, which can thus be dispensed with.[11]

English compounds are not derived by Merge, as defined in (53), the generalized transformation that builds syntactic structure bottom-up by combining two autonomous subtrees as daughters of a single node. This operation applies only in the derivation of syntactic objects. It does not apply in the derivation of morphological objects.

(53) Merge: Target two syntactic objects α and β, form a new object Γ {α,β}, the label LB of Γ(LB(Γ)) = LB(α) or LB(β). [(Chomsky 1995a)]

In Chomsky (2004), Merge subdivides into external and internal Merge. External Merge (53) applies to two syntactic objects and forms a new object; internal Merge (Move) displaces an already merged syntactic object. While external Merge is the indispensable operation of recursive systems, Move (54) implements the displacement property of natural languages. Uninterpretable features are checked under Agree (55), which plays a central role in both external Merge and internal Merge.

(54) Move: Select a target α, select a category β that is moved, β must have uninterpretable features, α must be phi-complete to delete the uninterpretable feature of the pied-piped matching element β, merge β in Spec-LB(α), delete the uninterpretable feature of β.

[11] Compounds have been argued to be X^0 domains derived in the syntax by Head-movement (Baker 1988; Lieber 1992a; Roeper, Snyder, and Hiramatsu 2002, among other works). A major puzzle concerning compounds is that even though Head-movement derives object-verb compounds (Baker 1988), it cannot account for adjunct-verb compounds. The derivation of compounds, be they object-verb or adjunct-verb, follows from the application of the same recursive structure-building operation along the lines of Asymmetry Theory. If compounds form a natural class, it is unlikely that they are derived by different operations, e.g., external merge and internal merge for object-verb compounds, and external merge only for adjunct-verb compounds. Furthermore, Head-movement is not a possible operation in the Minimalist Program. One reason is that it violates Chomsky's (2000) Extension Condition, according to which operations may only expand trees upwards. Another reason is that while it is assumed that XP traces/copies are interpreted as semantic categories of type <e> (Portner and Partee 2002), it is not clear how the trace/copy left by Head-movement is interpreted at the CI interface (LF). Furthermore, Head-movement cannot derive compounds including XP structure, and such compounds are found cross-linguistically. Thus, this operation faces theoretical and empirical problems. According to AT, Head-movement does not apply in the derivation of compounds because it is not a possible operation of the grammar.

(55) Agree

$\alpha > \beta$

$|\_\_|$

Agree (α, β), where α is a probe and β is a matching goal, and '>' is a c-command relation. Matching is feature identity. The probe seeks a matching goal within the domain XP, generated by the probe. Matching of probe and goal induces Agree.

As defined above, Move (internal Merge) and Agree cannot apply in the derivation of compounds because compounds are not syntactic XP domains.

According to Asymmetry Theory, both syntactic and morphological domains are derived by the recursive operations of the grammar. The primitives and the implementation of these operations differ, depending on whether the derivation takes place in the syntactic or in the morphological workspace. In the syntactic derivation, the recursive operation combines two autonomous subtrees as daughters of a single node, whereas in the morphological derivation, it combines two subtrees by substituting one tree to the complement position of the other.

In Asymmetry Theory, the properties of morphological expressions including compounds, such as strict precedence, strict scope, and atomicity, are not the consequence of construction-specific rules or conditions, but follow from the properties of the computational system. The model does not reduce morphology to syntax, while it allows similarities between the two subsystems to follow from their parallel architecture. The crucial difference between D_M and D_S is that D_M manipulates asymmetric relations only.

From the operations of Asymmetry Theory, it follows that compounds are virtually infinite expressions. In fact, recursive compounds are found cross-linguistically. For example, recursive compounds are found in French as well as in English, e.g. *acides aminés*, *acides aminés alpha* (Fr), cf. *amino-acids*, *alpha-amino-acids* (but see Roeper, Snyder, and Hiramatsu 2002 for a different view).

Moreover, since the recursive operations of D_M apply to minimal or derived trees, and a tree has a head by definition, it follows that headedness is a property of all compounds. The head of a morphological object with respect to a feature F is the highest sister-containing head M marked for F features.[12, 13]

[12] According to (i), a morphological object has more than one head. According to (ii), the head$_F$ is determined derivationally. Given (ii), the head of a compound may in some cases be legible only by the CI system, but not by the SM system.

(i) DEFINITION OF 'head$_F$' (read: head with respect to the feature F)
The head$_F$ of a word is the rightmost element of the word marked for the feature F.
(Di Sciullo and Williams 1987: 26)

(ii) DEFINITION OF *head$_F$* OF A MORPHOLOGICAL DOMAIN
The head$_F$ of a morphological domain D_i is the highest sister-containing head of D_i marked for the feature F.
(Di Sciullo 2005a: 42)

8.2.2 Morphological phases

The notion of 'phase' was introduced in Chomsky (2001) as a way to account for the cyclicity of syntactic operations, which is required for optimal computation. It is a local domain where uninterpretable features are checked and deleted in order to meet the Interface Interpretability Condition. The phase has an F-XP configuration, it is impenetrable, and it is isolable at the interfaces. The syntactic phase is propositional (vP, CP), and it is a complete functional complex.

In the Derivation-by-phase model, a constructed syntactic object is sent to the two interfaces by the operation Transfer, and what is transferred is no longer accessible to later mappings to the interfaces. The phase is part of the principles of efficient computation, since it reduces the computational load in the derivations. The complement of a phase is sent to Spell-Out and thus is no longer accessible for further computation – only the head and the edge (the specifier and the adjuncts) of a phase are.

I argued in Di Sciullo (2004, 2007a) that morphological derivations also proceed by phase, which contributes to reducing the computational complexity arising in the morphological derivation.[14]

Morphological and syntactic phases are parallel.[15] Similar to a syntactic phase, a morphological phase includes an F-XP configuration (see Di Sciullo 1996). Second, the Head_F of a morphological domain is the highest sister-containing head marked for the feature F (see Di Sciullo 2005a). Third, an affix asymmetrically selects the

Thus, in *postage stamp*, *stamp* is the $\text{Head}_{\text{category}}$ because it is the highest sister-containing head with categorial features. In *paper cutter*, the $\text{Head}_{\text{category}}$ is the affix *-er*, and in French *coupe-papier*, the $\text{Head}_{\text{category}}$ occupies the same position as in the equivalent English construction, but does not have legible features at the SM interface.

[13] Given the poverty of the stimulus in language acquisition, the child develops a grammar on the basis of his genetic endowment. Headedness might very well be a property of all compounds, even though there is no direct evidence of headedness in some compounds. If this is the case, then the traditional distinction between endocentric and exocentric compounds can be dispensed with.

[14] See Di Sciullo and Fong (2005) for the computational implementation of the model, and for an example of the reduction of the derivational complexity with cases such as *computerizable*.

[15] The notion of cyclic domain has been recently discussed in terms of Chomsky's (2001) notion of phase, Uriagereka's (1999, 2003) notion of Multiple Spell-Out, and Collins's (2002) notion of phase as a saturated constituent. See Adger (2003) and Holmberg (2001) for phonology, and Chierchia (2001) and Nissenbaum (2000) for semantics. A phase has the following properties: it is an F-XP configuration, it is subject to Impenetrability, and it is isolable at the interfaces (Chomsky 2001, Legate 2003, Adger 2003, Matushansky 2003). According to Chomsky (2001), a phase is a propositional category (vP, CP). Chomsky (2000) provides evidence that syntactic phases are propositional on the basis of examples such as

[John [t thinks [Tom will [t win the prize]]]]
and
[which article is there some hope [α that John will read t_{wh}]]

in which the lower propositional domain constitutes a domain of cyclic interpretation and spell-out. It has been shown that other categories besides propositions are syntactic phases; see Adger (2003) for DPs and Legate (2003) for VPs.

head of its complement (see Di Sciullo 1997, 2005a, and also Collins 2002 for syntactic selection).

Like a syntactic phase, a morphological phase is subject to the Interpretability Condition. According to Chomsky (2001), vP is a strong phase and thus opaque to extraction at the CP level. The only position from which extraction can take place is from the head and the edge (the specifier and the adjoined positions) of the phase. However, the morphological phase is subject to a stronger impenetrability condition than the syntactic phase. The edge of a morphological phase is accessible to the next phase up for uninterpretable feature-checking without leading to movement. Furthermore, a morphological phase is isolable at the interfaces, whereas its parts are not.

The locality restrictions on active feature checking, such as the ones illustrated in (56), follow from a morphological derivation by local domains. The operations of D_M derive morphological domains, where active features must be checked (deleted/valued) before the domains reach the interfaces in order to satisfy the Interface Interpretability Condition, which requires that each element be interpretable at the interfaces.

(56) a. $[_{\text{Asp-Ph}}$ un- Asp $[_{\text{Pred-Ph}}$ [α] -able [[β] deny [[δ]]]]]

X

b. $[_{\text{Op-Ph}}$ [γ] -s $[_{\text{Pred-Ph}}$ [α] -er [β] produce [δ]]]

X

c. Ph1 Spell-Out → [[β] produce [δ]]
Ph2 Spell-Out → $[_{\text{Pred-Ph}}$ [α] -er [[β] produce [δ]]]
Ph3 Spell-Out → $[_{\text{Op-Ph}}$ [γ] -s $[_{\text{Pred-Ph}}$ [α] -er [[β] produce [δ]]]]

For example, in (56a), the head of a Pred-domain is accessible to checking by an element in the Asp-domain, namely by the privative affix *un-*, but the complement of the Pred-domain is not.[16] The derived expression is correctly interpreted as a derived adjective, and not as a derived verb. In (56b), the flectional affix *-s* has two values: the plural inflection of nominal categories, and the third person singular present tense inflection of verbal categories. The head of a Pred-affix is accessible to operations from the next domain up, i.e. the Op-domain, but its complement is not. The derived morphological expression is correctly interpreted as a plural derived nominal, and not as the nominalization of a tensed verb.

Assuming that the material in the sister position of the head of a phase is spelled out and transferred to the interfaces, roots with their feature structures would be transferred to the interfaces first, independently from the full inflected expressions of which they are a part, spelled out subsequently, and no longer accessible to the

[16] Given the featural definitions in (58), in (56a) the aspectual feature $[-F_I]$ of the modifier affix *un-* is checked by the aspectual feature $[+F_I]$ of the secondary predicate affix *-able*, and in (56b), the [−Re] feature of the inflection operator *-s* is checked by the [+Re] feature of the *-er* affix.

computation (56c). Derivational complexity may also arise in the derivation of compounds, and morphological phases contribute to the efficiency of the computation. Recursive compounds are also derived by phases, where active (uninterpretable) features are deleted locally within and across phases. A feature of the complement of the lower phase, Ph_1, cannot enter into an Agree relation with a feature of the higher phase, Ph_2. Likewise, the parts of compounds are transferred to the interfaces independently (57).

(57) a. $[_{\text{Pred-Ph}}$ alpha F $[_{\text{Pred-Ph}}$ hydroxi F [α acid β]]]

X

b. Ph1 Spell-Out $\rightarrow$ [α acid β]
Ph2 Spell-Out $\rightarrow$ $[_{\text{Pred-Ph}}$ hydroxi F [α acid β]]
Ph3 Spell-Out $\rightarrow$ $[_{\text{Pred-Ph}}$ alpha F $[_{\text{Pred-Ph}}$ hydroxi F [α acid β]]]

According to Asymmetry Theory, the morphological phases are not determined categorically, but they are determined derivationally. A minimal morphological domain is the result of the application of first Merge, defined as in (53). A maximal morphological domain is a domain where the operation in (50), checking active features and relating interpretable features, may no longer apply. The morphological phases are defined within the limits of the Pred-domain, the Asp-domain, and the Op-domain, and uninterpretable feature-checking/elimination and feature-sharing take place within and across adjacent morphological phases.[17]

In AT, feature-checking applies to pairs of contra-valued features and results in the deletion/valuing of an active feature, that is, the negative value of a feature.[18] The morphological features, including the Argument [$\pm$A] and Predicate [$\pm$Pred] features, occupy the head and the dependents (specifier and complement positions) of the morphological trees, and are independently needed in the grammar. The combination of these features defines the morphological categories as follows:

(58) a. Pred-domain: argument: [+A, −Pred], primary predicate: [−A, +Pred], secondary predicate: [+A, +Pred], expletive: [−A, −Pred]

b. Asp-domain: external modifier: [$+F_E$, $-F_I$], internal modifier: [$-F_E$, $+F_I$], bare event: [+Ev, $-F_I$], participant: [−Ev, $-F_I$]

c. Op-domain: operator: [−X, −Re], variable: [+X, −Re], restrictor: [−X, +Re], dependents: [−X, −Re]

17 See also Marantz (2003), where abstract functional categories, including small v and small n, head the nominal and verbal phases, where each functional complex is a morphological phase.

18 Morphological and syntactic checking applies to different features and has different effects. While active syntactic features are associated with syntactic categories, such as Tense and Complementizer, active morphological features are associated with morphological categories such as argument (A) and predicate (Pred). Furthermore, syntactic checking may lead to overt movement, whereas this is not the case for morphological checking.

Interpretable features are also part of the morphological derivations. These features are the positive values of the features above, the referential [+R] feature for nominal categories of Di Sciullo and Williams (1987), the terminus [+T] and the subinterval features [+S] for event- delimiting categories, as defined in Di Sciullo (1997), and the small set of substantive features, namely [+human], [+thing], [+manner], [+time], [+place], [+reason], entering in the semantics for functional words, as defined in Di Sciullo (2005a).

The converging derivations yield interpretable morphological expressions, whereas derivations that do not converge, e.g. interface expressions with surviving active features, yield morphological gibberish. In the next section, I illustrate the active feature-checking in the derivations of compounds instantiating a modification relation (root compounds), a predicate–argument relation (verbal compounds), and an operator–restrictor relation (functional words).

I thus take a morphological phase to be a unit of morphological computation that starts with a morphological numeration and ends with Spell-Out. A morphological phase is a domain for cyclic interpretation and Spell-Out. It is a subsection of a morphological derivation.

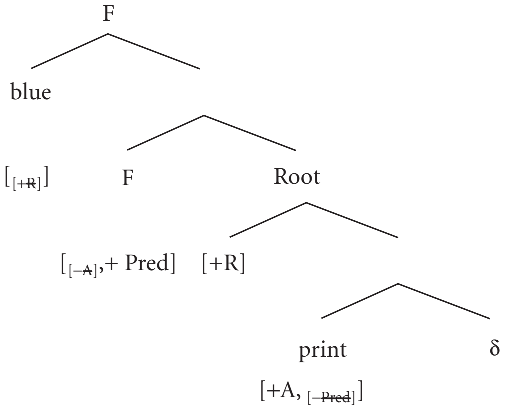
8.2.3 Derivations

8.2.3.1 *Root compounds*

Root compounds, such as *blueprint*, *paper bag*, and *dark blue*, instantiate a modification relation. Given AT, the non-head is a modifier (secondary predicate) of the head and thus occupies the specifier of a minimal tree headed by the functional head F:

(59) $[_{\text{Mod}}\ \text{Root}_2\ \text{F}\ [_{\text{Pred}}\ \text{Root}_1]]$

(60)



The root (primary predicate) merges with the modifier by the operation in M-Shift. This operation applies under Agree, defined in terms of the proper subset relation. Thus the features of the modifier must be a superset of the features of the

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modified root for a convergent derivation. Checking takes place, and the uninterpretable [−A] and [−Pred] features are deleted. Furthermore, M-Link creates a link between the two [+R] features, thereby directionally identifying the referential [+R] feature of the modifier *blue* to the referential feature of the head$_{\text{category}}$ of the construct, which is *print*, since it is the highest head with categorical features. The modifier *blue* has categorical features, but it is not a head (likewise for the modifier *paper* in *paper bag* and the modifier *dark* in *dark blue*). Thus, a root compound has only one referent even though it includes two [+R] roots.

(61) Numeration: $<$ [blue $[\underset{[+\mathrm{R}]}{\mathrm{F}_{[-\mathrm{A},\ +\mathrm{Pred}]}}$ $[\chi]]$, [[+R] [print$_{[+\mathrm{A},\ -\mathrm{pred}]}$ δ]]] $>$

(62) D_M: 1. [blue $[\underset{[+\mathrm{R}]}{\mathrm{F}_{[-\mathrm{A},\ +\mathrm{Pred}]}}$ $[\chi]]]$

2. [[+R] [print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$ $[\delta]$]]]

3. [blue $[\underset{[+\mathrm{R}]}{\mathrm{F}_{[-\mathrm{A},\ +\mathrm{Pred}]}}$ [[+R] print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$ $[\delta]$]]]] by M-Shift

4. [blue $[\underset{[+\mathrm{R}]}{\mathrm{F}_{[-\cancel{\mathrm{A}},\ +\mathrm{Pred}]}}$ [[+R] print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$ $[\delta]$]]]] by M-Link

5. [[blue $[\underset{[+\mathrm{R}]}{\mathrm{F}_{[-\cancel{\mathrm{A}},\ +\mathrm{Pred}]}}$ [[+$\cancel{\mathrm{R}}$] print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$ $[\delta]$]]]] by M-Link

6. [[blue $[\underset{[+\cancel{\mathrm{R}}]}{\mathrm{F}_{[-\cancel{\mathrm{A}},\ +\mathrm{Pred}]}}$ [[+$\cancel{\mathrm{R}}$] print$_{[+\mathrm{A},\ -\cancel{\mathrm{Pred}}]}$ $[\delta]$]]]] by M-Link

The result of the derivation in D_M (i.e. step 6 in (62)) qualifies as a morphological phase and thus can be transferred to D_Σ, where it is interpreted by the semantic rules as a predicate, a category of semantic type <e, t>, and to D_Φ, where M-Flip does not apply, since the edge of the phase (the specifier of the F-tree) has SM-features, that is, *blue* occupies this position. The transferred phase in (63) has no formal or semantic features, but only phonetic features interpretable at the SM interface, where only phonetic, but not formal or semantic features are interpreted.

(63) D_Φ: 1. [[] [blue [F [] print []]]] by Transfer from D_M to D_Φ

Given the feature matrices in (58a), we correctly predict that expletives, such as *it* or *there*, cannot be part of compounds because uninterpretable [−Pred] features will be left unchecked (see (64)) as they reach the CI interface, and the expression will fail to satisfy the Interface Interpretability Condition.

(64) a. I saw a nice blueprint of the Venice conference poster.
b. *I saw a nice it-print of the Venice conference poster.
c. *I saw a nice there-print of the Venice conference poster.

(65) a. $[_{\mathrm{F}}$it $\mathrm{F}_{[-\cancel{\mathrm{A}},\ -\mathrm{Pred}]}$ $[_{\mathrm{Pred}}$ print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$]]
b. $[_{\mathrm{F}}$there $\mathrm{F}_{[-\cancel{\mathrm{A}},\ -\mathrm{Pred}]}$ $[_{\mathrm{Pred}}$ print$_{[+\mathrm{A},\ -\mathrm{Pred}]}$]]

The derivation of English root compounds brings additional evidence to the hypothesis that active feature-checking applies in morphological domains.

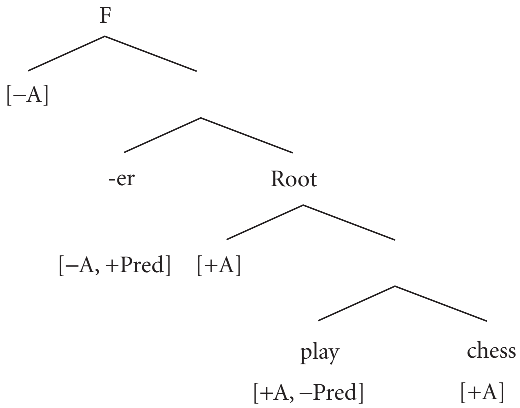
8.2.3.2 *Verbal compounds*

Verbal compounds, such as *chess player*, instantiate a predicate–argument relation, and they may also instantiate a modification relation, as in *dirty player* (i.e. someone who plays dirty). I focus on the first subtype.

Given AT, in a deverbal compound the bare noun occupies the complement position of the tree headed by the base verb, and the affix occupies the head of the functional projection containing the verbal structure, (66), (67).

(66) $[_F\ \alpha\ \text{af}\ [_{Pred}\ \beta\ [\text{root}\ \delta]]]$

(67)



We illustrate the derivation of verbal compounds with the derivation of *chess player* in (69), concentrating on the uninterpretable [−A] feature located in the non-head position of the nominal affix. Given the numeration in (68), the first step in the derivation is the transfer of the minimal tree headed by the verb *play* from the numeration to the morphological workspace. The second step is the transfer of the minimal tree headed by the noun *chess*. Given that the features of *play* properly include the features of *chess*, M-Shift applies and yields the representation in step 3. The next step is the transfer of the minimal tree headed by the primary (Pred_1) affix -*er* to the workspace. M-Shift applies at step 5, attaching the structure obtained at step 3 to the complement position of the nominal affix. Agree is satisfied since a primary affix may take a root as its argument. In the last step of the derivation, M-Link applies to the structure obtained at step 5, and the uninterpretable [−A] feature of the nominal affix is deleted by the closest [+A] feature.[19] At Step 6, M-Link applies again, given that the Pred_1 affix -*er* is lexically determined to saturate the

[19] A [−A] feature occupies the edge of the phase, since -*er*, unlike a causative affix, does not have a [+A] feature in this position.

external argument of the verbal root with which it merges. This can be seen by the fact that an adjunct *by*-phrase may not be interpreted as an agent (70).

(68) Numeration: < [[−A] [-er [+A]]], [[+A] play [+A]], [α [chess β]] >

(69) D_M:
1. [[+A] play [+A]]
2. [α [chess β]]
3. [[+A] play [α [chess β]]] by M-Shift
4. [[−A] [-er [+A]]]
5. [[−A] [-er [[+A] play [[α [chess β]]]]]] by M-Shift
6. [[−A] [-er [[+A] play [[α [chess β]]]]]] by M-Link
7. [[−A] [-er [[+A] play [[α [chess β]]]]]] by M-Link

(70) a. A chess player came in.
b. The chess player by John.
c. John's chess player.

The linear order of the constituents is derived in the D_Φ workspace by the transfer of the result of the derivation that took place in D_M, namely step 1 in (71), and by the application of M-Flip, namely step 2 in (71). M-Flip applies in this derivation since there are no SM-legible features at the edge of the phase (i.e. in the specifier of the affixal head).

(71) D_Φ:
1. [[] -er [[] play [chess]]] by Transfer from D_M to D_Φ
2. [[chess] play [-er]] by M-Flip

The derivation of English verbal compounds is based on the same operations as the ones applying in the derivation of deverbal nouns, such as *player* ((72)–(74)). The argument feature of the root can be saturated in the morphological derivation. The examples in (75) show that it can be saturated in the derivation of a compound, but it cannot be saturated naturally (see (75c), which is not fully acceptable to my informants) in the derivation of a syntactic phrase. This is not the case for event nominals however, such as *destruction*, e.g. *the destruction of the city.*

(72) Numeration: < [[−A] [-er [A]]], [[+A] [play [+A]]] >

(73) D_M:
1. [[+A] play [+A]]
2. [[−A] [-er [+A]]]
3. [[−A] [-er [[+A] play [+A]]]] by M-Shift
4. [[−~~A~~] [-er [[+~~A~~] play [+A]]]] by M-Link

(74) D_Φ:
1. [[] -er [[] play []]] by Transfer from D_M to D_Φ
2. [play [] [-er]] by M-Flip

(75) a. John plays chess.
b. John is a chess player.
c. (?)John is a player of chess.

Given the feature matrices in (58a), we correctly predict that expletive pronouns, such as *it* or *there* (76), cannot be part of verbal compounds either because uninterpretable [−A] features will be left unchecked, see (77), as they reach the CI interface, and the expression will fail to satisfy the Interface Interpretability Condition.

(76) a. *John is a great it-player.
b. *Mary enjoys there-players a lot.
c. *It-players are hermits.

(77) a. $[_{F}$ it $F_{[-A,\ -\cancel{Pred}]}$ $[_{Pred}$ -er $_{[-A,\ +Pred]} \ldots]]$
b. $[_{F}$ there $F_{[-A,\ -\cancel{Pred}]}$ $[_{Pred}$ -er $_{[-A,\ +Pred]} \ldots]]$

The restrictions imposed by the nominal affix *-er* on the head of its complement are met in the derivation in (73), and asymmetric Agree holds between the selector and the selectee. The active [−A] feature occupies the specifier position of the affix *-er*, and it is checked/deleted by the [+A] feature of the specifier of the root *play*. However, in the derivation in (79), the active [−A] feature of *-er* cannot be checked by the [+A] feature of the root, since *arrive* has a [−A] feature in its specifier position.[20] Thus M-Link does not apply in the derivation. Thus, the derivation in (79) yields morphological gibberish (#*arriver*). This expression fails to satisfy FI at the interface, since it includes active features.

(78) Numeration: < [[−A] [-er [A]]], [[−A] arrive [+A]] >

(79) D_M: 1. [[−A] arrive [+A]]
2. [[−A] [-er [+A]]]
3. [[−A] [-er [[−A] arrive [+A]]]] by M-Shift

(80) D_Φ: 1. [[] -er [[] arrive []]] by Transfer from D_M to D_Φ
2. [[arrive []][-er]] by M-Flip

As discussed in Di Sciullo (2005a), *arriver* is possible within verbal compounds including a modification relation, as is the case in the examples in (81), resulting from a Google search. This fact suggests that compounding interacts with derivation in the derivation of morphological domains. Furthermore, it indicates that in compounds including modification relations, the modifier is higher than the secondary and the primary predicate domains; see (82), including examples with *depart* and *fall*, which are also unaccusative.

(81) a. Are you an early arriver or late arriver Movie Forum?
b. The late arriver definitely needs counselling, but not on class time.
c. The late arriver is perceived as less sociable and less competent than early or on-time arrivers.

[20] Unaccusative verbs such as *arrive* have one argument feature only, and it is located in the complement of their minimal tree.

(82) [early F [[−A] -er [[−A] arrive [+A]]]]
[late F [[−A] -er [[−A] depart [+A]]]]
[easy F [[−A] -er [[−A] fall [+A]]]]

In Di Sciullo (2005a) I provided an analysis of these structures in terms of argument structure type-shifting. Argument structure type-shifting is the structural face of semantic type-shifting. M-Link applies in (83) and relates the features of the F-head to the features of the verb, bringing about a change in the argument structure of the verbal head, which shifts from an unaccusative to an unergative argument structure (83), thus satisfying the requirements imposed by the nominal affix -*er* on its complement. The uninterpretable [−A] feature in the specifier of this affix is deleted by entering into an Agree relation with its new closest [+A] feature.

(83) [early F [[−A] -er [[+A] arrive [−A]]]]
[late F [[−A] -er [[+A] departer [−A]]]]
[easy F [[−A] -er [[+A] faller [−A]]]]

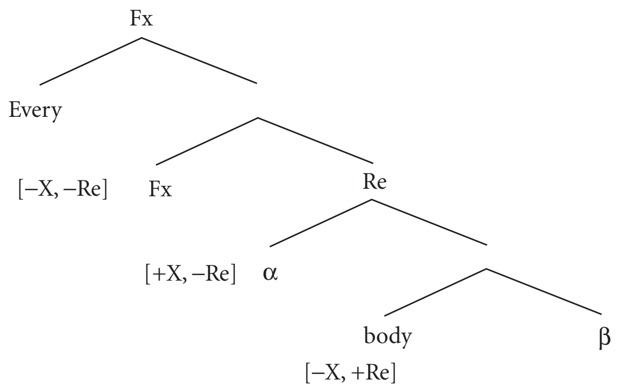
The derivation of verbal compounds brings additional evidence to the hypothesis that active feature-checking applies in morphological domains. See Di Sciullo (2007a) for evidence from deverbal nouns and adjectives in Italian.

8.2.3.3 *Functional compounds*

Functional words, such as determiners and quantifiers, instantiate an operator–restrictor relation, where the operator occupies the edge of the morphological phase, the variable occupies the head of the F-tree, and the restrictor occupies the head of the complement of that phase, as illustrated in (84), (85), with *everybody.*

(84) $[_{Fx}$ Root$_2$ F $[_{Re}$ Root$_1]]$

(85)



According to AT, quantifiers, as well as other functional words, have an internal morphological structure, derived in D_M, as can be seen in the derivation in (87)–(88), given the numeration in (86). M-Flip does not apply at D_Φ (87), since *every* occupies the edge of the phase.

(86) Numeration: $<$ [every [F [χ]]], [[β] body [δ]] $>$

(87) D_M: 1. [every$_{[-X,\ -Re]}$ [F$_{[+X,\ -Re]}$ [χ]]]
2. [[α] [[body$_{[-X,\ +Re]}$ [δ]]]]
3. [every$_{[-X,\ -Re]}$ [F$_{[+X,\ -Re]}$ [[β] body$_{[-X,\ +Re]}$ [δ]]]]
by M-Shift
4. [every$_{[-\cancel{X},\ -\cancel{Re}]}$ [F$_{[+X,\ -\cancel{Re}]}$ [[β] body$_{[-\cancel{X},\ +Re]}$ [δ]]]]] by M-Link

(88) D_Φ: 1. [every F [body []]] by Transfer from D_M to D_Φ

We correctly predict that operators cannot merge with predicates or arguments in the morphological derivation; they may only merge with restrictors, cf. (89a) vs. (89b). Thus, *every house* and *every print* are not morphological domains, they are syntactic domains, whereas *everyone* and *everybody* are morphological domains. They qualify as morphological phases, they have an F-XP structure, and they are strongly impenetrable. For example, an adjective cannot occupy an intermediate position. Their stress pattern is typical of compound stress, and their interpretation is fixed, as illustrated above in (45)–(48).

(89) a. [$_{Op}$ every$_{[-X,\ -Re]}$ [F $_{[+X,\ -Re]}$ [$_{Res}$ body$_{[-X,\ +Re]}$]]]
b. [$_{Op}$ every$_{[-X,\ -Re]}$ [F $_{[+X,\ -Re]}$ [$_{Pred}$ house$_{[-A,\ +Pred]}$]]]

The derivation of functional compounds also provides evidence in support of the hypothesis that active feature-checking applies in morphological domains.

8.2.4 Summary

Morphological phases are the local domains of morphological computation. The locality of active morphological feature-checking makes morphological domains parallel to syntactic domains. The strong impenetrability of morphological phases, and the fact that they are not of the same semantic types (e.g. <e, t> vs. < t >), make them different semantic objects. Furthermore, as mentioned earlier, syntactic and morphological phases are not the same type of phonological object, considering the fact that they are subject to different stress rules, which, according to Asymmetry Theory, have parallel derivations.

8.3 Interpretability

Recent works on the language faculty (Hauser, Chomsky, and Fitch 2002; Chomsky 2004) suggest that the narrow syntactic component of the language faculty (FLN) satisfies conditions of highly efficient computation, and could be close to an optimal solution to the problem of linking the sensorimotor (SM) and the conceptual-intentional (CI) systems.[21] In other words, the language system would provide a near-optimal solution that satisfies the Interface Interpretability Condition given the central role of asymmetry in the derivations.

(90) Interface Interpretability Condition
Only interpretable elements in asymmetric relations are legible at the interfaces. (Di Sciullo 2005a: 34)

According to Asymmetry Theory, language is the best solution to the interface legibility conditions because the asymmetry of linguistic expressions matches with the asymmetry of the external systems. The Interface Interpretability Condition relates to work in physics and biology/genetics (Thompson 1992, Hornos and Hornos 1993, among others), according to which asymmetry breaks the symmetry of natural laws, and brings about stability in an otherwise unstable system. In this perspective, Jenkins (2000) suggests that word order is an expression of the symmetry-breaking phenomenon. I developed a model of the language faculty where asymmetric relations are hard-wired, the operations of the morphology apply to objects that are already asymmetric, and their asymmetry is preserved through the derivation. It is likely that, at the interfaces, the asymmetric relations between the interpretable elements of linguistic expressions enable contact with the external systems.

Fiorentino and Poeppel (2007) investigate morphophonological decomposition in compounds using visual lexical decision with simultaneous magnetoencephalography (MEG), comparing compounds, single words, and pseudo-morphemic foils. According to Fiorentino and Poeppel, the behavioural differences suggest internally structural representations for compound words, and the early effects of constituents in the electrophysiological signal support the hypothesis of early morphological parsing. These results accord with the ones reported in Di Sciullo and Tomioka (2007), which provide behavioural support for Asymmetry Theory, according to which compounds are formed of elements in asymmetrical relations. The results of the semantic priming with Japanese object–verb and adjunct–verb compounds indicate that adjunct–verb compounds take longer to process than object–verb compounds. This suggests that human perception is sensitive to the difference in the underlying structures. More structure is processed in the case of the adjunct–verb compounds, such as *ni-zukuri* (Ja), lit. 'stick stand'='stand straight', than in the case of object–verb compounds, such as *bou-dati* (Ja), lit. 'parcel make'='parcel-making'.

In N+V compounds in languages such as Japanese, there is no overt element indicating the sort of relations between the constituents. In some cases the noun is

[21] The FLN corresponds to overt syntax and differs from the language faculty in a broad sense (FLB), which includes the external systems, CI and SM.

an object of the verb, and in other cases it is an adjunct. Yet, these compounds are efficiently processed. The question is then: what enables this processing? Given Asymmetry Theory, compound processing is enabled by the presence of unpronounced functional heads with interpretable features. On the one hand, these functional heads ensure that compounds have an asymmetric structure cross-linguistically. On the other hand, they enable morphological compositionality (91)

(91) Morphological Compositionality
The interpretation of a morphological object (MO) is a function of the interpretation of its morphological feature structure.

According to (91), the interpretation of a compound is more abstract than the interpretation of its pronounced constituents. Given (91), a unified account can be given to the interpretation of the different sorts of compounds. Thus a *mousetrap* is a trap to catch mice, and a *hairbrush* is an instrument to brush hair, but a *redneck* is not a neck, it is a person who lives in the American south with certain political views. The substantive semantic properties relating the parts of compounds fall into the realm of encyclopedic knowledge. The properties of these features are not part of the genetic endowment of FLN. They are the result of the interaction between FLB and knowledge of the world.

Morphological compositionality abstracts away from the standard definition of semantic compositionality, according to which the interpretation of a constituent is a function of the interpretation of its audible parts and the way the parts are syntactically related. The substantive features of the parts of a morphological object are not sufficient in the interpretation of the whole object. Independent evidence comes from *cran*-morphemes, which do not have independent substantive semantic features outside of the *berry* paradigm, as well as forms that have different denotations outside of compounds, such as *step* in *stepsister*, and the like. The abstract morphological features and the way they enter into agreement and linking are determinant in the interpretation of these constructs. The morphological compositionality of compounds also crucially relies on the presence of unpronounced heads, with constant meaning. The substantive content of the parts of compounds is provided ultimately by the CI systems, interfacing with encyclopedic knowledge, a topic we leave for further research.

8.4 Summary

Thus, compounds are a part of natural languages because they are derived by the recursive operations of the language faculty. The fact that compounds may include recursive structure follows as a direct consequence. Moreover, the recursive operation deriving compounds is limited to a structure-building operation. Head movement or Internal Merge (Move) may not apply in the derivation of compounds. In other words, the derivation of compounds does not require more generative power than a context-free grammar, whereas the derivation of phrases and sentences requires the generative power of a context-sensitive grammar.

On the one hand, I argued that compounds can be a part of languages because their properties, and in particular their asymmetric properties, are derived by the recursive operation of the language faculty. On the other hand, I argued that compounds are a part of human language in addition to phrases and sentences because they meet the interface legibility conditions in a different way from phrases and sentences. Specifically, morphological compositionality ensures the interpretability of these constructs, which may override the substantive features of their SM-legible parts.

The rationale offered by Asymmetry Theory for the presence of compounds in human language targets fundamental properties of the language faculty instead of external factors, such as the principles of semantic transparency, simplicity, conventionality, and productivity (Clark and Berman 1984, Clark, Hecht, and Mulford 1986).