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Patron:

Journal Title: Semantics : an international handbook of natural language meaning /

Volume: 3
Issue:
Month/Year: 2012
Pages: 2151-2172

Article Author: Heidi Harley

Article Title: Semantics in Distributed Morphology

Imprint: Berlin ; New York : De Gruyter Mouton, ©

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81. Semantics in Distributed Morphology

Abstract

This article introduces the grammatical framework of Distributed Morphology, with special attention to the implications of the framework for semantic interpretation. The derivation of a sample sentence is given, illustrating the dissociation between the semantically contentful abstract units which are the input to syntactic and semantic composition, and the phonologically contentful Vocabulary Items which compete to realize them. The central assumptions of the framework are contrasted with those of more established Lexicalist approaches, particularly with respect to the predictions for bracketing paradoxes, the Mirror Principle and the status of lexical roots. Areas in which Distributed Morphology has produced developed semantic proposals are described, including argument structure operations, idiomatic interpretation, the interpretation of nominal features, and the nature of on-line speech errors.

1. Introduction

Distributed Morphology (DM) is a morphosyntactic framework which employs the same combinatoric and interpretive mechanisms for both word-formation and phrase-formation. Viewed in this way, morphology just *is* syntax, and vice versa. The locus classicus for the framework is Halle & Marantz (1993).

Given the assumption that morphology is syntax, and given that in modern Minimalist syntactic theory, syntactic representations are deterministically mapped to semantic representations, many DM analyses make significant semantic predications, and semantic evidence is often brought to bear in the DM literature. Many practitioners have employed the term 'morphosemantics' to describe their research.

This article attempts first to give the reader a feel for the structure of the framework, providing an introductory overview and a toy example of a derivation within the theory. Then certain differences between DM and more traditional Lexicalist approaches are remarked upon, touching on issues such as bracketing paradoxes and the question of whether word-formation has any special semantic effects or status. Then the paper provides a brief tour of some particularly significant issues within the theory, including argument structure, lexical decomposition, idiomatic interpretation, underspecification, zero morphology, nominal ('phi') feature interpretation and semantically-motivated speech errors.

2. Distributed Morphology: The framework

As noted above, DM is a framework for morphological, syntactic and semantic analysis in which word-formation is primarily a syntactic operation, in the usual sense of

Maienborn, von Heusinger and Portner (eds.) 2012, Semantics (HSK 33.3), de Gruyter, 2151–2171

'syntactic'. That is, the same mechanism that generates complex phrasal structure also generates complex morphological structure. There is only one 'generative engine' in the theory. In that sense, the theory does without a conventional generative lexicon. There are no lexicon-internal operations which create or operate on complex word-forms prior to their being fed into the syntactic computation. One consequence is the prediction that there can be no morphological operations that implement non-monotonic semantic changes. This is because semantic content can be added to a complex structure but not deleted from it by the introduction of a new terminal node with new semantic content. Hence morphology, like syntax, is predicted to obey the Monotonicity Hypothesis (Koontz-Garboden 2007).

In DM, the primitive elements which the combinatoric system operates on are abstract bundles of syntacticosemantic features, for example [PL] ('plural') or [√CAT] ('cat'). These feature bundles have denotations which are the input to semantic composition and interpretation after syntactic computation is complete, at the level of Logical Form (LF). There are two broad categories of items in this first list. Roots, or l-morphemes, like [√CAT], whose final interpretation includes Encyclopedic information, will determine the idiosyncratic aspects of the final semantic representation. Abstract Morphemes, or f-morphemes, like [PL], provide the functional structure and make deterministic semantic contributions. (In Chomsky's famous *Colorless green ideas* sentence, the 'semantic ill-formedness' which the sentence was intended to illustrate results from incompatibilities in the Encyclopedic content of the Root morphemes in the sentence. The functional elements are both syntactically and semantically coherent—in other words, the sentence has a well-formed LF.)

The mental storehouse of these feature bundles is termed List 1 (see the diagram in Fig. 81.1), and provides the raw material from which the syntactic computation begins. The contents of List 1 vary from language to language, both the particular Roots on the list and the particular content of the abstract grammatical feature bundles being determined during acquisition, subject to constraints imposed by Universal Grammar and the acquisition mechanism.

The operations which combine these bundles of features into larger hierarchical structures are essentially those of Minimalist syntactic theory. A subset of feature bundles is selected as input for combination (the Numeration). These feature bundles undergo the Merge, Agree, and Move operations, subject to relevant syntactic requirements, such as the Minimal Link Condition (Chomsky 1995), which constrains the potential targets of the Agree and Move operations.

As in garden-variety Minimalism, the derivation reaches a point at which it must be interpreted by the phonological and semantic interfaces, called Spell-Out. Here, the derivation branches. On the way to the interface with phonology, the syntactic representation is subject to some purely morphological operations, then morphophonological ones, before the final PF form is reached. Similarly, on the way to the semantic interface, it could be the case that some specialized operations apply to the syntactic representation to achieve an interpretable Logical Form. Most crucially, the phonological realization of the terminal nodes of the syntactic structure is determined on the way to PF, by an operation called 'Late Insertion'. The elements of List 1 have no phonological content. Purely phonological information about the realization of lexical items is therefore not present at the LF interface. For example, the LF representation does not 'see' the morphological difference between the realization of the [PL] feature as *-en* in *children* and as *-s* in *cats*; the LF

representations of both words contain just the same [PL] feature, and are interpreted accordingly.

The Late Insertion operation, on the PF branch, accesses a second list of information, specifying phonological realizations associated with particular feature bundles. The elements of this List 2 are termed "Vocabulary Items" (VIs). Importantly, VIs may be underspecified—the VI which is inserted to realize a particular feature bundle may be listed with only a subset of the features contained in the bundle. Insertion of Vocabulary Items proceeds according to a 'best fit' principle: the VI which wins insertion is the VI whose feature specification comes the closest to matching the features of the terminal node without containing any clashing features. Consider a pronominal terminal node specified for [+1, +SG, +NOM] (a first person singular subject), and three hypothetical VIs with different feature specifications, as illustrated below:

Terminal node	*Vocabulary items*
$D_{[+1, +sg, +Nom]}$	'ba' ⇔ [+1]
	'da' ⇔ [+1, +Nom]
	'ga' ⇔ [+2, +sg, +Nom]

The *ga* VI is not eligible to realize the terminal node, because it refers to the clashing feature [+2]. Both *ba* and *da* are eligible for insertion, as their features are a subset of the terminal node's, but *da* wins out over *ba* because *da* refers to more compatible features than *ba* does. This best-fit competition for insertion thus obeys Kiparsky (1973)'s *Elsewhere Principle.* (VIs may also be conditioned by features on other terminal nodes in the surrounding syntactic context; the same Elsewhere Principle applies.)

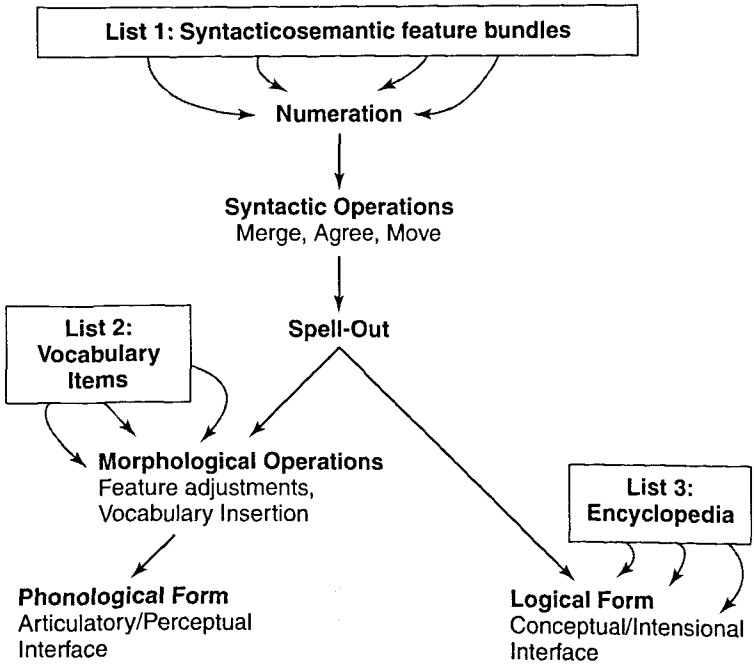


Fig. 81.1: The Distributed Morphology Model

Over at the LF interface, besides the normal semantic composition which computes the denotation of the syntactic representation, special information is accessed concerning the interpretation of particular Root items in the syntacticosemantic context in which they now appear. Both idiomatic and conventional interpretations of Roots are represented in this third list of idiosyncratic information, called the Encyclopedia or List 3. This special information composes with the denotations of the f-morphemes to produce the final interpretation of the structure. Standard model-theoretic semantic mechanisms of composition, those adopted by semanticists working in a broadly Minimalist context (e.g. like those in Heim & Kratzer 1998), are employed.

A schematic of the overall model is presented in Fig. 81.1.

2.1. Sample derivation

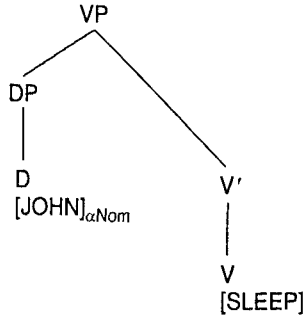
As an illustration of the kind of mechanisms at play, a toy derivation of the sentence *John slept*, with very basic assumptions concerning the denotations of the feature bundles involved, is illustrated below. Overall, the type of syntax-semantics interface outlined in article 82 (von Stechow) *Syntax and semantics* is assumed to apply.

Step 1: Selection of syntacticosemantic features from List 1. (I follow Demirdache & Uribe-Etxebarria (2007) in using 'i' to represent a variable over time intervals.)

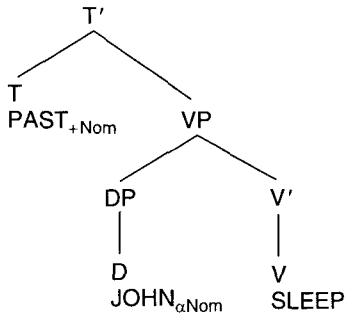
Feature(s)	Denotation
$[JOHN]_{D, \alpha Nom}$	The relevant individual named 'John'
$[PAST]_{T, +Nom}$	$\lambda i.[BEFORE(utterance\text{-}time, i)]$
$[SLEEP]_{V}$	$\lambda x.\lambda e.[SLEEP(e, x)]$

Step 2: Syntactic derivation. (I am assuming the VP-Internal Subject Hypothesis. I also silently include projection of the determiner $[JOHN]_D$ to a DP as well as projection of the verb $[SLEEP]_V$ to a V'. In fact, under Bare Phrase Structure assumptions (Chomsky 1995), $[JOHN]_D$ in this configuration is simultaneously a head and a phrase, and non-branching projection does not occur.)

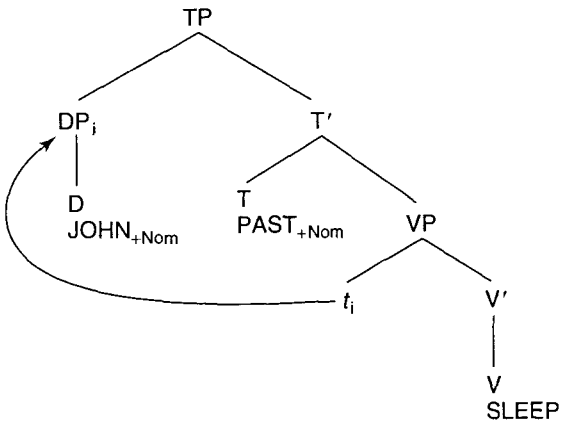
(i) $[JOHN]_{D, \alpha Nom}$ undergoes Merge with $[SLEEP]_V$, producing a VP:



(ii) $[PAST]_{T, +Nom}$ undergoes Merge with the VP, producing a T' constituent:



(iii) The active [+Nom] Case feature within the $[PAST]_T$ feature bundle Probes its c-command domain for a Case feature with which it can Agree, finding $[JOHN]_{D, \alpha Nom}$. The DP headed by $[JOHN]_{D, \alpha Nom}$ undergoes Move to Spec-TP, where it enters into Spec-Head Agreement with $[PAST]_{T, +Nom}$. This results in a fully convergent syntactic structure with no unchecked features:



Step 3: Spell-Out

The representation in (iii) above is sent for interpretation to the LF and PF interfaces. I first present a sketch of the derivation of the LF interpretation, then that of the PF interpretation.

Step 3.1: LF Interpretation

(i) The denotation of VP is computed by composing the denotation of the V with the denotation of the chain $\{DP_i, t_i\}$, which (especially under the 'Copy' theory of movement) is identical to the denotation of the DP.

$$[[VP]] = \lambda e[SLEEP(e, \text{'John'})]$$

Standardly, the VP [JOHN SLEEP] denotes a function from events to truth values such that f(e) = 1 iff e is an event of John sleeping. The identity criteria with which the speaker identifies sleeping events as such are contained in the List 3 entry for the

l-morpheme [SLEEP]—they are part of the content of the Encyclopedia, accessed once the final LF is determined.

(ii) Existential closure at the VP binds the event variable, asserting the existence of a John-sleeping event.

$$[[VP]] = \exists e[SLEEP(e, \text{'John'})]$$

(iii) Type mismatch resolution: The $[PAST]_T$ feature is a function from time intervals to truth values, but at this point the VP's denotation is not a time interval. For the purposes of this illustration, I assume that before the VP is composed with T°, some operation applies that maps the event denoted by the VP to the time interval during which it takes place—something like the Temporal Trace Function τ proposed in Krifka (1998) (see article 57 (Ogihara) *Tense* for discussion). This function could conceivably enter the derivation as the denotation of some feature bundle occupying an intermediate head position between VP and TP (e.g. an Asp° head), but I will treat it here as an LF-specific compositional operation which applies just when this type mismatch is detected. This would be an example of a kind of special semantic operation which the PF computation could never be sensitive to, as it applies after the split at Spell-Out—a semantic analogue of the special morphological operations that can apply to adjust the representation on the way to PF. Following the application of this operation, very roughly speaking, the VP denotes the unique time interval during which the sleeping event took place:

$$[[VP]] = (\text{ii})\lambda i[\exists e[SLEEP(e, \text{'John'}))] \ \& \ DURING(e,i)]]$$

(iv) The denotation of T' is computed by composing the denotation of T with that of the VP:

$$[[T']] = BEFORE(\text{utterance-time}, (\text{ii})\lambda i[\exists e[SLEEP(e, \text{'John'})] \ \& \ DURING(e,i)])$$

i.e. The unique time during which there was an event of John sleeping was before utterance time.

(v) For present purposes, let us assume the denotation of TP is the same as that of T', since the DP-chain has already been interpreted within the VP—i.e., reconstruction has applied.

Step 3.2: PF Interpretation

Each terminal node in the syntactic structure is associated with a morphophonological Position-of-Exponence which must be filled by a phonological exponent—a Vocabulary Item—in order for the structure to be pronounced. Terminal nodes filled by traces or other empty categories explicitly marked as lacking a PF representation are excluded.

(i) Linearization: The hierarchical structure of the syntactic tree is linearized according to the Head Parameter setting for the language. In the case of English, specifiers are on the left and complements on the right of their heads, as in the tree diagrams above. By hypothesis, however, the linear order among terminal nodes is not relevant until PF; the hierarchical structure is all that matters for the computation of syntactic relations and for LF.

(ii) At this point, some operation is necessary to ensure that the PAST suffix is realized attached to the V within the VP, rather than above it in the T position. Following Bobaljik (1994), I'll assume that Morphological Merger applies to the $[PAST]_T$ terminal node and the $[SLEEP]_V$ terminal node, essentially lowering the T° head to form a complex segment with the V° head. This English-specific example of Morphological Merger is essentially a technical implementation of affix-hopping within the DM framework. It is also an example of the kind of PF-specific operation whose effects are never seen in the LF representation.

(iii) Now Late Insertion begins, by hypothesis from the Root morpheme upwards (though nothing in the framework would preclude top-down insertion of VIs; see section 4.6 below for discussion). The Vocabulary Items which compete for the l-morpheme SLEEP are accessed from List 2. I will assume that two such items are present in English, since SLEEP is an irregular verb (alternatively there could be just one, [slijp], which is subject to a special vowel-shortening morphophonological readjustment rule later in the derivation, as Halle & Marantz (1993) originally proposed). The first of our two VIs for SLEEP is specified for insertion in the environment of a +PAST Tense node, and the second is available for all other contexts—i.e. it's the 'elsewhere' item.

SLEEP ⇔ /slɛp/ / [[PAST]$_T$ ___]
SLEEP ⇔ /slijp/ elsewhere

The first VI wins insertion at the terminal node for SLEEP since it is a better fit in the current context than the second.

(iv) The Vocabulary Items specified for the f-morpheme $[PAST]_T$ are accessed. Again, there are several such VIs in English. Each of the irregular PAST VIs is specified for input in the context of particular l-morphemes:

PAST ⇔ ∅ / [___ { [HIT] / [RUN] / [SIT] / ... }]

⇔ /t/ / [___ { [FEEL] / [MEAN] / [LEAN] / ... }]

⇔ /d/ elsewhere

In this case, the elsewhere morpheme /d/ wins insertion, since [SLEEP] is not on any of the lists conditioning the insertion of the irregular suffixes ∅ or /t/.

(v) The Vocabulary Items specified for the individual-denoting $[JOHN]_D$ (in fact, probably better represented in List 1 as a simple index which receives an interpretation under an assignment at LF) are accessed. There's only one:

[JOHN] ⇔ /ʤɑn/

(vi) Phonological constraint satisfaction: The terminal nodes all having been realized with VIs, the structural representation is now something like this, with the vacuous T' brackets eliminated for clarity:

$$[[/ʤɑn/]_{DP}[/slɛpd/]_{VP}]_{TP}$$

The string of phonemes is then subject to English-specific phonological allomorphy, adjusting the voicing in the word-final consonant cluster /pd/ in /slɛpd/. The past-tense suffix surfaces as [t] in the environment of the stem-final voiceless consonant [p] to its left. The string is then phonetically interpreted, with the correct intonational contours, stress, allophonic selection, etc, surfacing as [ˈʤɑn ˈslɛpt].

With this impression of the details of a DM derivation in mind, let us explore some of the semantic ramifications of the framework.

3. Differences with lexicalist approaches

3.1. Absence of bracketing paradoxes

In DM the same interpretive mechanisms are employed to compute the meaning of complex syntactic phrases and complex word-forms; such computations are often interleaved. For example, assuming bottom-up composition, the denotation of the VP [$_{VP}$ love [$_{DP}$ Mary]] in the sentence *John loved Mary* will be computed before the contribution of the T° node is composed with the denotation of the VP; there is no need to compute a meaning for the phonological word *loved* before composition of the verb with the direct object. In a strongly Lexicalist model, *loved Mary* is a kind of bracketing paradox, since the interpretation of Tense scopes over the whole VP, while the morphological realization of Tense is within the domain of the verb only—inside the word *loved* that occupies the V° node in the tree. No such puzzles arise in DM. The fact that the past tense morpheme *-ed* is affixal and the future tense morpheme *will* is an independent word is an epiphenomenon of the particular Vocabulary Items which are inserted to realize the Tense node; it has no effect on the relative order of semantic composition. Tense and the VP in *John loved Mary* are composed in the same order that they are in *John will love Mary*. Similarly, the classic example *transformational grammarian* can be analyzed in the syntax and at LF as having the structure [[*transformational grammar*]-*ian*]; the fact that the element *-ian* is affixal becomes relevant only at PF.

3.2. Mirror Principle is entailed

The architecture entails that a scopally-motivated order of affixation should be the norm, as in the analysis of Athapaskan morphology presented in Rice (2000). The observation that morpheme order generally reflects syntactic hierarchies—and hence the order of semantic composition—has been implemented in some form or other in Chomskyan grammar since Baker (1985) proposed the Mirror Principle. In DM, the Mirror Principle effect falls out of the architecture of the theory; deviations from it must be explained, but the general existence of the effect is entailed.

3.3. The special status of Roots

A consequence of treating syntactic and morphological composition with the same mechanism is that morphological phenomena must be taken seriously by those interested in clausal semantics. In DM, there is a guiding assumption that all overt morphological exponents represent the realization of some syntactic terminal node. This extends to derivational morphology, which has further consequences for syntactic structure and semantic interpretation. For example, it becomes important to characterize the syntactic and semantic role of the terminal nodes realized by derivational morphemes like *-ize* and *-ify* (verbal), *-tion* and *-ness* (nominal), and *-al* and *-y* (adjectival).

Such categorizing nodes have the special property of being able to compose directly with Root morphemes. DM suggests that Roots are a-categorial, and must Merge with a categorizing f-morpheme (or more than one, in cases like $[[[[nomin]_{\sqrt{}}al]_a iz]_{\sqrt{}}ation]_n$). This categorizing morpheme provides the Root to which it attaches with a syntactic category. Further, since all Roots must occur with at least one such categorizer, the Encyclopedia provides the Root with a fixed interpretation in the context of particular categorizers. The hypothesis that Roots are acategorial, achieving interpretable status only through composition with v°, n° and a° heads, is a key component of the framework, allowing a characterization of the different but related contribution of, for example, the root $\sqrt{ELECTR}$-in *electr-on* (Noun) and *electr-ic* (Adjctive) and *electr-ify* (Verb). This theoretical feature has been particularly exploited in the DM analysis of Semitic root-and-pattern morphology proposed in Arad (2003, 2005).

(Note that the toy derivation provided in section 2.1 above does not include a separate $\sqrt{}$ projection for √SLEEP embedded under verbalizing v° morpheme. Rather, it started with the result of the combination of v° and √SLEEP, the verb SLEEP, although such decomposition is standardly assumed in the framework. The usual interpretation assumed for the individual terminal nodes of unergative verbs is based on Hale & Keyser (1993)'s proposal, $[DO\ [SLEEP]_{\sqrt{}}]_{\sqrt{P}}$. See Harley (2005, forthcoming) for further discussion of the type-theoretic denotations of roots.)

3.4. The phonological word has no special status in semantic interpretation

Erasing the borders between morphological and syntactic composition in this way allows the resolution of several empirical conundrums. One positive consequence is that the typological differences between polysynthetic and isolating languages do not require the postulation of radically different combinatoric and compositional mechanisms in UG. For example, true noun incorporation constructions (Baker 1988), in which the incorporated nominal object forms part of the complex verb, can be structurally and semantically identical to pseudo-noun-incorporation constructions like those in Niuean (Massam 2001) and Hindi (Dayal 2003). In pseudo-noun-incorporation, a bare nominal acts semantically as if it's incorporated—it is interpreted in the same way as in cases of genuine morphological incorporation like those documented by Mithun, Baker, and others—even though it retains its morphophonological autonomy as a separate word. (See article 44 (Dayal) *Bare noun phrases* for relevant discussion.) In DM, at LF, status as a word or multiple words is irrelevant. In a more familiar example, the LF structure and

interpretation of English comparatives can be treated as uniform regardless of the variable affixal status of the comparative morpheme (*-er* vs. *more*, Embick 2007), without causing any major theory-internal upset at the morphology/syntax interface. What is more, semantic proposals about the LF operations required to interpret comparatives, for example QR of the Degree Phrase headed by *-er* after Spell-Out, need not necessarily be concerned with the question of whether the QR operation will dissociate a suffix and its host, since at the point at which QR applies, the issue of whether the actual phonological realization of the Deg head is an affix or not is irrelevant. (Thanks to Ora Matushansky for this point. Interesting questions still arise, however, concerning the realization of comparative adjectives, particularly with respect to suppletion in the realizations of certain Roots; e.g. the Root √BAD is realized alternatively as *bad, worse,* or *worst* depending on the content of the Deg feature bundle in its immediate context. See Bobaljik (2007) and article 53 (Beck) *Comparison constructions* for relevant discussion.)

The same point holds cross-linguistically. Both affixal and non-affixal complex forms can both be purely compositionally interpreted or idiosyncratically, idiomatically interpreted. A good example is the equivalent interpretations of the morphologically complex English *awaken* and the syntactically complex Persian complex predicate *bîdar shodan*, 'awake become' (Folli, Harley & Karimi 2005). More trivially, it is clear that phrases can have both literal (compositional) and idiomatic interpretations, as in *kick the bucket.* Similarly, morphologically complex words can also have both literal and idiomatic interpretations. The famous example case *transmission* can refer idiomatically to the relevant car part, or literally, compositionally, to the event or result of transmitting. There is no principled reason that morphophonological unification within a single phonological word should necessarily trigger a special semantic interpretation (Marantz 1997). Multimorphemic and multi-word expressions can in principle represent the same structure and receive the same interpretations. Wordhood confers no privileged semantic status.

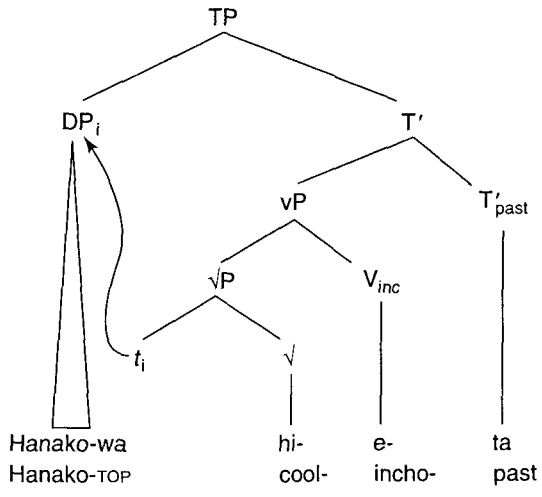
However, as noted above, although there is no morphophonologically motivated semantic domain, the acategorial Root hypothesis entails that there is at least one such morphosyntactic dividing line, at the point at which the categorizing head is composed with the Root (Marantz 2001, Arad 2003)

4. Morphosemantics in Distributed Morphology

4.1. Argument structure

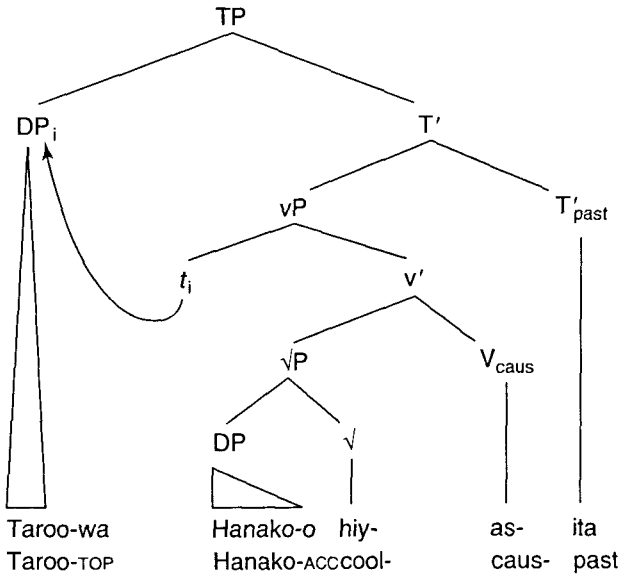
In many, perhaps most, languages, diathesis alternations are realized by the addition or alternation of overt verbal morphology. In DM, this entails that argument structure alternations are effected syntactically. The notion that external arguments are introduced by a separate verbal projection, for example, first proposed by Hale & Keyser (1993), provided DM approaches with a natural first hypothesis concerning the locus of causative and inchoative verbal morphology, which is cross-linguistically common (indeed, such morphology was part of the original motivation for the proposal.) For example, the unaccusative Japanese verb *hie-*, 'cool, intr.' is made up of a root *hi-*plus an inchoative morpheme *-e-*. Its causative counterpart, *hiyas*, is the same root *hi-*plus the causative morpheme *-as-*. The additional external argument correlates with the change in suffixal morphology; it is natural to ascribe the addition of the former to the semantic contribution of the latter:

a.



"Hanako cooled off."

b.



"Taroo cooled Hanako off."

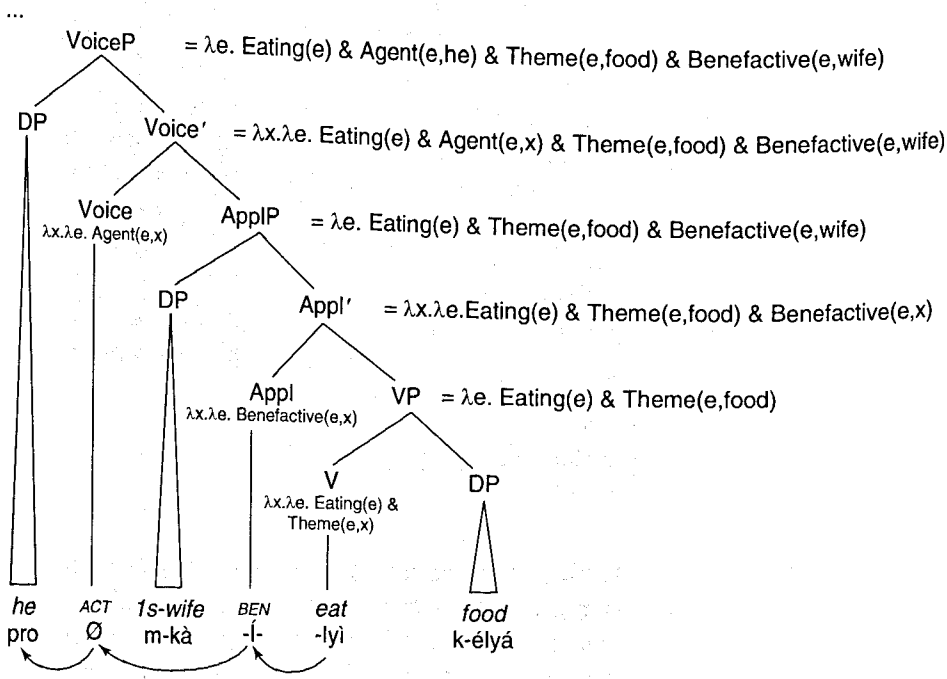
Given such complex syntactic structures for the causative and inchoative forms in Japanese, the source of apparently word-internal scope ambiguities with adverbials like *again* ('repetitive' vs 'restitutive' scope) should be clear: such scope ambiguities are syntactic ambiguities, resulting from the decomposition of the form into a constituent denoting 'cool' and another phrasal element meaning 'cause'. Such analyses thus represent the re-introduction of many of the key ideas of the Generative Semantics work in the late 60s and early 70s. (See article 17 (Engelberg) *Frameworks of decomposition* for relevant discussion.)

Given this kind of approach to argument structure, it is a short step to recognize that similar analyses are necessary for other argument-structure introducing morphology. For example, applicative morphemes, which add an internal argument to the argument

structure of agentive verbs, can occupy a position between the upper, external-argument-introducing head and the lower verb Root, which selects for the verb's usual internal arguments. This accounts for the syntactic prominence of the applied argument compared to other internal arguments (McGinnis 2003). Semantically, the Applicative head expresses a relationship between an individual (the applied argument) and an event (Pylkkänen 2002). The Applicative head composes with the lower VP and the higher vP via Kratzer (1996)'s Event Identification operation. It simply adds an event-modifying predicate and expresses the relationship between its new argument and the event. Nothing special needs to be said about the semantics of the VP or the vP; they have just the (Davidsonian) interpretation which they normally would. Pylkkänen's syntactic structure and semantic interpretation for a straightforward benefactive applicative sentence from Chaga is given below:

a. N-ˊa-ˊí-**lyì-í-**à **m-kà k-élyá**
FOC-1s-PR-**eat-APPL**-FV **1-wife 7-food**
'*He is eating food for his **wife***'
(Bresnan & Moshi 1993:49)

b. *Syntactic constituent structure* *Denotation of constituents*



As indicated by the arrows in the diagram, head movement of V through Appl, Voice and the higher functional projections (not shown) assembles the complex constellation of feature bundles that will be realized as the final verb form and derives its sentence-initial position. (Kratzer and Pylkkänen use the term 'Voice' for the external-argument introducing position, rather than vP; Pylkkänen reserves the label 'vP' for a purely verbalizing head lower in the structure. For our purposes here, the difference is not crucial, however.)

4.2. Zero morphemes

In DM, it is frequently necessary to posit the existence of zero morphology. For example, the diathesis alternation between English *melt* (intr.) and *melt* (tr.) is accomplished without any overt change in morphology. The semantic and syntactic changes that are observed, however, require that a syntactic projection is present but not overtly morphologically realized. By hypothesis, this syntactic projection is realized by a zero morpheme. (The deployment of zero morphemes means that DM analyses are not literally engaging in lexical decomposition when the verb 'melt' is represented in a structure as $[[\text{cause}]_v\ [\text{melt}]_{\sqrt{}}]_{vP}$; the 'cause' content is contributed by a separate head realized by a zero morpheme, not by the verb 'melt' itself.)

Similarly, a zero morpheme is needed to block the insertion of default *-s* into the PL terminal node which is necessarily present on the noun in the DP *These sheep*—without a zero morpheme, the form *These sheeps* would surface, given the mechanisms of the theory.

Above we saw that it is axiomatic in DM that a surface realization must correspond to some kind of structure in the morphosyntactic system, and hence can often be taken as evidence for the presence of some element in the semantic representation as well. The reverse is emphatically not the case: syntactic and semantic evidence can point to the existence of structure that receives no realization in the phonological representation. This is not a surprise—the existence of syntactically and semantically motivated empty elements has been a cornerstone of modern generative syntax—but it is a controversial point within morphological theory. Indeed, within DM, the nature of a 'zero' morpheme is a matter of some disagreement. Considering VIs to be sketches of instructions for the articulatory system, one possibility is that a zero morpheme could be considered an instruction to 'do nothing'. However, no consensus has emerged on the correct way to model a 'zero' realization.

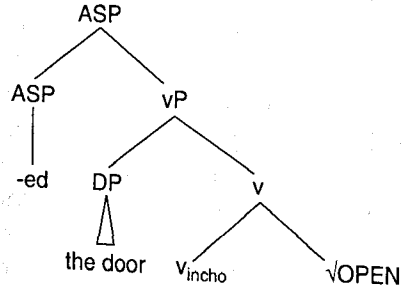
4.3. Underspecification

As we have seen above, in DM, the relationship between a terminal node's feature content and the Vocabulary Item which realizes that terminal node is subject to underspecification: The Vocabulary Item which best fits the content of the terminal node realizes it phonologically, but the featural match between the two need not be exact. The DM framework thus helps break the assumption that a given piece of morphophonology should in principle correspond to only one meaning. This has proven helpful in understanding the syntacticosemantic structure involved in several puzzling cases where the same morphological formative appears to be behaving semantically in two or more distinct ways, as in for example, the analysis of the interaction of causative and reflexive morphology in Kannada in Lidz (2003).

One particularly fruitful line of analysis along these lines has considered the composition of apparently identical morphological items with distinct levels of syntactic structure, dubbed in Harley (2008) the *High/Low Attachment Hypothesis*. Participial morphology in many languages seems to have the option of attaching to an event-denoting constituent in the verbal projection and receiving an eventive passive interpretation, or attaching to a lower constituent and receiving a stative interpretation (Marantz 1997, Embick 2004, Kratzer 2001, Jackson 2005, Alexiadou & Agnastopoulou 2008, *inter alia*). The point is

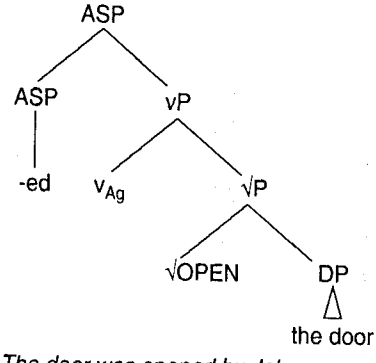
made in great detail in von Stechow (1998), in which the distinct semantics of no less than four constructions in German, all employing Participle II morphology, are analyzed and given distinct model-theoretic interpretations. The 'Transparent Logical Form' von Stechow argues for is very much in line with the elaborate vP syntax proposed in the related Distributed Morphology work. The puzzle of how such distinct interpretations can be realized by identical morphology is resolved when it is realized that the morphology may be sensitive just to a subset of the syntacticosemantic features involved—even a very minimal subset, such as category information. Below, I illustrate Embick (2004)'s distinct structures for English resultative participles and eventive passive participles. The key feature of the analysis is that both involve an Asp(ect) head (though see Maienborn 2009 for an opposing view). The default 'elsewhere' morpheme for spelling out this Asp head is the *-ed* suffix, which is why the same morphology can appear in structures with such very different kinds of interpretations:

a. Resultative participle



The door is opened.

b. Eventive passive participle



The door was opened by John

Similar effects have been observed cross-linguistically in causative morphology (Miyagawa 1998, Travis 2000, Svenonius 2005, *inter alia.*) Harley (2008) provides a detailed discussion of the Japanese case.

4.4. Nominal features and their interpretation

The relationship between the morphological realization and the semantic interpretations of certain syntacticosemantic feature distinctions (for example, the various values of

person, number and gender features) has been a key question in DM and related research, e.g. Rullman (2004), Cowper (2005), McGinnis (2005a), Harbour (2007), Sauerland (2008), Acquiviva (2008), inter alia. It is axiomatic that the same alphabet of features constitutes the input to the semantics and the morphological component, and there has been a great deal of work on understanding the relationship between the features and the morphological exponents that realize them. The morphologist's traditional 'feature bundle' has usually been syntactically decomposed, as in Ritter (1992), but the semantic contributions and compositional reintegration of the various features, however, is less well understood. Several very interesting results have emerged, however.

Harbour (2006) reports the remarkable observation that the semantic content of the feature [±augmented] (a cardinality-neutral alternative to the [Plural] feature) has essentially the same semantics as Krifka (1992)'s crucial definition of cumulativity.

Harbour gives the following definition of augmented:

A predicate, P, is *augmented* iff

$$\exists x \exists y[P(x) \wedge P(y) \wedge x \supset y]$$

i.e. iff it is satisfied by two individuals, one containing the other, an individual being an atom or a set of atoms.

The notion of augmentation was first proposed as the correct way to characterize number systems like that of Ilocano, which has a 1st person inclusive plural form, referring to speaker, hearer and at least one other. This plural form contrasts with another first person inclusive form referring just to the speaker and the hearer. The cardinality of the non-plural inclusive form is not 1, so it is inappropriate to use the feature [singular] (or [-plural]) to describe it. Since the form is of cardinality 2, the traditional terminology calls it a 'dual', but this results in positing the Dual category just for the first person inclusive non-plural, within such languages:

Person	Singular	Dual	Plural
1 incl		-ta	-tayo
1 excl	-ko		-mi
2	-mo		-yo
3	-na		-da

Using the feature [+augmented], with the semantics given above, results in a much more satisfactory cross-classification:

Person	-Augmented	+Augmented
1 incl	-ta	-tayo
1 excl	-ko	-mi
2	-mo	-yo
3	-na	-da

Harbour treats the person specification as the basic predicate of the pronominal which the [+augmented] feature modifies, so, for example, a '1 incl' pronoun has as its denotation the predicate 'includes Speaker and Addressee'. '1 excl' is the predicate 'includes Speaker and excludes Addressee'. Given the semantics for 'augmented' above, consider

the denotation of the [1incl, +aug] pronoun *tayo*. The [+aug] feature asserts that $\exists x \exists y$[INCLUDESSp&Ad(x) $\wedge$ INCLUDESSp&Ad (y) $\wedge$ x $\supset$ y]—that is, it says that the model must contain two individuals, both containing 'Speaker' and 'Addressee', the one individual contained in the other. Minimally, then, the model contains {Speaker, Addressee, Other}, since this model contains the individual {Speaker, Addressee} and the individual {Speaker, Addressee, Other}, and the former is contained in the latter.

Applied to 2nd person, on the other hand, [+augmented] just requires that the model contain minimally {Addressee, Other}. 2nd person is the predicate 'includes Addressee'. Applied to this predicate, the {+aug} feature asserts $\exists x \exists y$[INCLUDESAd(x) $\wedge$ INCLUDESAd(y) $\wedge$ x $\supset$ y]—that, the model must contain two individuals, both containing Addressee, such that one individual contains another. The minimal model {Addressee, Other} can accomplish this, since it contains {Addressee} and {Addressee, Other}, the former contained in the latter. Of course, models with more than one 'Other' entity will also satisfy a [+aug] form. The potential referents for, e.g., the [+2, +aug] pronouns, then, will be exactly "Addressee and one or more others"—precisely the denotation necessary for a second person plural form. [+Augmented], then, allows for the expression of plurality without reference to specific cardinality.

Harbour goes on to show that augmentation entails additivity for non-cardinality predicates, and that augmentation and additivity together entail Krifka's notion of strict cumulativity, and vice versa. Krifka could thus have characterized the event-object homomorphism in terms of [+augmented], rather than [+cumulative].

Acquaviva (2006, 2008) develops a related characterization of the contribution of the Num and Classifier heads within DP, in which Classifier Ns behave like Numberless measure terms, essentially taking the place of the Number head (*pound, liter, inch*, etc.) and are characterized by abnormal number morphology, adducing evidence from the semantic characteristics of nominals with irregular number morphology in the complex number systems of the Goidelic languages.

(See also articles 40 (Büring) *Pronouns* and 78 (Kiparsky & Tonhauser) *Semantics of inflection* for more developed discussion of nominal features and related issues.)

4.5. Interpretation of idioms

The characterization of idiomatic expressions has been a recurrent theme in the Distributed Morphology and related literature (Kratzer 1996; Marantz 1996, 1997, 2001; Richards 2002; Arad 2005, *inter alia*.) As noted above, one issue has concerned the semantic contribution of the Root element, which necessarily has an arbitrary, Encyclopedic interpretation (see Harley 2005 for some discussion of the semantic ontology for Root elements). Recall that while Root elements have Encyclopedia entries, while functional morphemes do not; consequently Roots can be specified for idiomatic interpretation, sometimes restricted to very elaborate interdependent syntactic and semantic contexts, while functional morphemes cannot. Functional morphemes must contribute their standard denotation to any structure which they find themselves in. So, for example, the expression *Put a sock in it!* does not literally instruct the addressee to do anything with a sock. Nonetheless, it is still formally and effectively an imperative, and it does consequently instruct the addressee to do *something*. The semantic contribution of the functional elements in the clause is inescapable.

McGinnis (2002) puts these assumptions together with the results of recent work showing a deterministic relationship between a predicate's event structure and the functional superstructure of the clause, including the definiteness, plurality, etc. of the object or other verbal complement. She argues that, while idiomatic interpretations of particular phrases can vary dramatically from their literal counterparts, they should *not* be able to vary from them in their event structure characteristics. So, for example, the idiom *She was the cat's pyjamas* is stative, as shown by standard tests such as the (in)ability to occur in the progressive (*#She was being the cat's pyjamas*); similarly, the (nonsensical) literal interpretation of the same sentence is also a state. The idiom *Harry jumped through hoops* is an atelic activity predicate, as diagnosed by its ability to co-occur with *for an hour* adverbials; similarly, the literal interpretation of the same sentence is also an atelic activity predicate (with an iterative atelicity contributed by the plural DP *hoops*).

Importantly, roughly synonymous non-idiomatic expressions need *not* have the same Aktionsart properties as their idiomatic synonyms. So, for example, while the phrase *kick the bucket* is commonly glossed as *die*, *die* and *kick the bucket* behave differently with respect to certain event structure tests. The well-formedness of the progressive in *He was dying for weeks*, which exhibits the pre-event focus typical for Achievement predicates in the progressive, is not paralleled in *kick the bucket*: *#He was kicking the bucket for weeks* is impossible, or at best gives the impression that he was dying, coming back to life, and dying again for weeks. That is, *kick the bucket*, in its idiomatic interpretation, behaves exactly like its literal interpretation, a punctual semelfactive predicate which is coerced to an iterative reading in the environment of *for-an-hour* adverbials. McGinnis's observation, then, provides important confirmation of the fundamental DM distinction between the deterministic semantics of functional elements and the Encyclopedic content of Roots. (Glasbey (2003) objects to McGinnis' generalization, adducing a class of putative counterexamples; McGinnis (2005b) responds. See articles 20 (Fellbaum) *Idioms and collocations*, 34 (Maienborn) *Event semantics* and 48 (Filip) *Aspectual class and Aktionsart* for relevant discussion of idiomaticity, event semantics, and Aktionsart.)

4.6. Psycholinguistic semantics, speech errors and Distributed Morphology

Finally, it is worth noting that the DM model has been shown to be isomorphic in many ways to the most broadly adopted psycholinguistic model of speech production. In a study of a large corpus of German speech errors, Pfau (2000, 2009) notes that a key feature of DM—Late Insertion of phonological material—is also a key feature of the two-stage speech production model first proposed in Garrett (1975) and developed further in Levelt (1989) et seq. Further, many DM mechanisms, understood in the context of a model of on-line production, can be useful in capturing certain patterns of behavior.

In the two-stage models, the message to be articulated, once conceptualized, is first syntactically organized, requiring access only to grammatical and semantic information. Only after this process is complete are the phonological exponents of the lemmas retrieved. That is, a two-stage model is essentially a Late Insertion model.

One of the crucial features of such frameworks is their ability to model the intriguing differences between "semantically-motivated" and "phonologically-motivated" speech errors. In semantically-motivated speech errors, an Encyclopedically-related word is

substituted for the intended production (e.g. *magazine* for *newspaper*). The model locates this error in the first, conceptually-driven, stage of lexical access—in DM terms, the point of access of List 1, the syntacticosemantic primitives that are the input to the syntactic derivation. This error consists of extracting a related but incorrect Root element from List 1 for inclusion in the derivation.

Semantically-driven errors occur prior to insertion of phonological material. Consequently, the realization of associated functional morphemes may be adjusted depending on the identity of the incorrect Root, if the morphemes happen to be conditioned by the Roots in their environment. Consider, for example, the speech error reported by Fromkin (1973), *I think it's **careful** to measure with reason*, an error for the intended production, *I think it's **reasonable** to measure with **care***. In this error, two noun stems in the intended production are correctly selected, but are inserted into each other's places in the syntactic structure. The key thing to note is that this affects the adjective-forming suffix which appears. Rather than produce the result that would obtain from a straight swap—***careable***—the adjective-forming suffix is instead realized as *-ful*. In a non-Late-Insertion model, this would have to be modelled as a deletion and replacement of an already-present *-able* suffix. In DM, however, the adjective-forming morpheme has no phonological content at the point of exchange. When the phonological exponents are inserted at the end of the derivation, everything proceeds normally: $[[\sqrt{CARE}]_{\sqrt{}}\ adj]_{aP}$ triggers insertion of the root 'care', and then the appropriate adjective-forming suffix conditioned by that root, *-ful* (not *-able*).

Pfau illustrates this basic point with a wealth of additional examples from German, showing, for example, that semantically-motivated noun-exchange errors in which the erroneous noun is of a different gender than the intended noun result in accommodation for gender agreement on determiners and adjectives in the DP—exactly as predicted if the derivation proceeds normally in the DM fashion, following the erroneous insertion of the nominal. The syntax will copy the nominal's gender features in agreement operations and consequently spell them out with the appropriate Vocabulary Items at Late Insertion. In a model in which the phonological form of the various feature bundles is present from the beginning, the selection of the erroneous nominal would result in feature clash between the nominal and the intended determiners, adjectives, etc, and an abnormal derivation would result. The production of the accommodated gender agreement would involve either rewriting the items and their features during the course of the derivation, or else a flat-out crash in the derivation; either way, speech errors of this kind would represent a major dysfunction in the production mechanism. With a Late Insertion, two-stage model, however, the whole derivation proceeds smoothly after the initial error is made—a scenario which appears to be much more consistent with the behavioral data.

5. Conclusion

For many semantic purposes, the issue of which particular syntactic framework is adopted can seem moot. However, in sincere attempts to determine the semantic contributions of specific morphological formatives, the choice of framework can push an analysis in widely differing directions. If the past tense formative composes with the verb, rather than the verb phrase, while the future tense formative composes with the verb phrase, they will have to have quite different types, for example. I hope to have shown that by adopting a Distributed Morphology view of the morphology/syntax connection, several issues in

semantic analysis can receive insightful analyses, carving the linguistic data at their joints, rather than at word boundaries.

Acknowledgement

I would like to gratefully acknowledge the helpful suggestions of Paolo Acquaviva, Andrew Koontz-Garboden, Jeff Lidz, Ora Matushansky, Andrew Nevins, Milan Rezac and especially Andrew Mcintyre. Any shortcomings in this discussion do not, of course, reflect in any way on them, and remain entirely my fault and responsibility.

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