6. Word anatomy: The internal structure of complex words

Anatomical Museum at Christ Church in 1857.
Gathered around the skeleton of a fish are, from left to right, Dr. George Rolleston, professor of anatomy; William Robertson, demonstrator of anatomy; and undergraduates Augustus Vernon Harcourt and Heywood Smith. Photograph by Charles Lutwidge Dodgson, ca. 1857.

To recapitulate. For us, morphological analysis, so far, consists in:

- segmenting word-forms into morphs, = minimal differences of form that can be systematically matched to minimal differences of meaning or grammar;

- unifying (allo-)morphs as realisations of one and the same morpheme if, despite having distinct forms, they have the same meaning/grammar and are in complementary distribution (hence are unable to contrast);

- dealing with relations of allomorphy depending on:
  - the kind of the alternation itself (phonological or not),
  - the kind of its conditioning (phonological, morphological, semantic, lexical);

- thereby accounting for certain relationships of dependency: the selection among allomorphs depends on some other part of the same word;
• classifying of morphemes
  • by status:
    free, lexical or bound, grammatical
    = word, stem, root = affix or other exponent of terms of morphological categories or category bundles
  LEXEME
  GRAMMEME ("function word")
  GRAMMEME

• by meaning:
  persons, animates, things, actions, events, properties etc. (general criterion: time stability?);
  more concrete [= typically LEXEMES] vs. more abstract meanings (e.g. plural, future) [= typically GRAMMEMES]
• by position, especially in the case of affixes:
  • before, after, inside, around the stem
    (prefix, suffix, infix, circumfix, ambifix)
  • closer to or more distant from stem/edge of word-form
    cf. un-de-cipher-abil-ity, re-place-ment-s,
    anti-dis-establish-ment-ar-ian-ism
    (Is this only a question of order?)

• Is there anything else about the structure of words that we have so far disregarded?

This is the question we are looking into now.
Ai Weiwei, *Template*, installation at documenta 12, swept down by a thunderstorm

http://www.flickr.com/photos/wolfgangstaudt/1402852146/in/set-72157602070098419/
6.1. Templatic ("flat") word structure

If the correct answer is "no": Templatic (or "flat") morphology

That is, word structure consists in linear (= temporal) sequences of immediate constituents (morphs), which at the same time are the ultimate word constituents;

- these are ordered in terms of position classes relative to stem/root and the word edge,
- with the ordering regulated by universal or language-particular rules,
- and with the possibility of one-way or mutual dependencies among position classes (‘if position class \( n \) is occupied by \( x \), position class \( m \) must be occupied by \( y \))

This is all there is in the case of templatic word structure.
Word structures are not always and everywhere templatic, but templatic word structure does exist, in many languages and for at least subparts of their morphological systems.

It seems that inflectional morphology is especially prone to be templatic. (The distinction of INFLECTION and DERIVATION will occupy us later.)
Examples of templatic morphology

• Predicates (verbs, adjectives, nouns) in Kekchí:

(i) TENSE/ASPECT – Agent/Subject:PERSON.NUMBER – Stem_{dynamic/Verb}
(ii) Stem_{static/Adjective} – Agent/Subject:PERSON.NUMBER
(iii) Possessor:PERSON.NUMBER – Stem_{Noun} – Possessor:3PL

Relations among occupants of position classes:

if Stem_{static}, then no TENSE/ASPECT

(Also notice different ordering of Agt/Sbj:PRS.NMB depending on whether the Stem is dynamic or static.)
• Verbs in **German**:

(i) **Stem** (– **TENSE:PRETERITE**) – **Subject:** **PERSON.NUMBER(.TENSE)**

(ii) **PARTICIPLEII** – **Stem** – **PARTICIPLEII**

**Relations** among occupants of position classes:

if Stem is a strong verb (a lexical classification, but morphologically and phonologically supported), then **TENSE:PRETERITE** is expressed through change of stem vowel instead of dental suffix immediately after verb stem;

if **PARTICIPLE**, then no **TENSE** and no **Sbj:** **PERSON.NUMBER**, and vice versa.
• Verbs in **Latin**

\[ \text{[Root – THEME]}_{\text{Stem}} – \text{TENSE1} (– \text{TENSE2}) – (\text{MOOD:SUBJUNCTIVE2} – ) \text{ MOOD} \]

\[ – \text{Sbj:PERSON.NUMBER} – \text{ DIATHESIS} \]

**Note:**  
TENSE1: PRESENT, IMPERFECT, FUTURE, PERFECT  
TENSE2: PLUPERFECT, FUTURE EXACT  
DIATHESIS: PASSIVE (ACTIVE remains unmarked)

Details elsewhere (**Homework exercises**.)
• Verbs in (Congo) **Swahili**

(Data from Nida, pp 12-13, Problem 5, see separate PDF)

**Another opportunity to practise morphological analysis.**


(NEG) (CAUSATIVE) – (PASSIVE)

Relations among occupants of position classes:

if **NEGATION**, then no **TENSE**;
if **CAUSATIVE** and/or **PASSIVE**, then no **REMOTE**, and vice versa.
Categories and terms:

PERSON: 1, 2, 3
NUMBER: SG, PL
TENSE: PRESENT, PRETERITE, FUTURE; REMOTE
MOOD: INDICATIVE (final -a)

Allomorphy: -iw/-w; ha/-h; ni/-i-
Homonymy?: ni/-ni-; wa/-wa-; mu/-mu-
extended exponence?: ha- ... -ta-
cumulation?: si-
The issue of the ordering of the parts of templatic word-wholes

Ordering in terms of position classes can be (or seem) ad hoc/arbitrary, requiring stipulation for each particular case in each particular language (thereby complicating the task of the learner of that particular language); or it may follow more general morphological, syntactic, semantic, or phonological principles.

Here are some such general principles that may play a role for the arrangement of the parts of templatically-organised words/word-forms:

- Word HEADS may consistently, in all complex words/word-forms of a language, come either before or after their DEPENDENTS. Hence no need to learn how to order each individual head and dependent. (More on heads and dependents presently.)
• The ordering of morphological markers may correspond, directly or in mirror-image order, to the syntactic constructions of which the words/word-forms concerned are part of.

Example from Old Georgian, a Kartvelian/South Caucasian language:

\[ \text{ḳlite-n-i sasupevel-isa ca-ta-jsa-n-i} \]

key-PL-NOM kingdom-GEN heaven-PL.OBL-GEN-PL-NOM

'(the) keys of the kingdom of (the) heavens'

The final noun has no less than four suffixes:

(i) in \( ca-ta-jsa-n-i \) the PLURAL.OBLIQUE suffix -ta comes first/innermost because this suffix identifies the number reference ('more than one') as well as (cumulatively) the syntactic function of this noun phrase itself within its construction, that of attribute (in the plural there is no separate genitive for attributes, but a general oblique case for all non-subject functions);
(ii) next comes the GENITIVE suffix -\textit{jsa} (a phonologically conditioned allomorph of -\textit{isa}), which indicates that the noun (phrase) \textit{ca}- syntactically belongs with a head noun (phrase) that is itself in the genitive case: that noun (phrase) is \textit{sasupevel-isa};

(iii) last/outermost in the sequence of suffixes are PLURAL -\textit{n} followed by NOMINATIVE -\textit{i}, which indicate that ultimately the noun (phrase) carrying these suffixes syntactically belongs with a head noun (phrase) which has plural reference and is itself in the nominative case: that noun (phrase) is \textit{ḳlite}.

Thus, in Old Georgian, plural marking is not only used to identify the number reference of a noun (phrase) and case marking is not only used to identify the functions of noun phrases (\textit{internal number and case marking}), but also to indicate the agreement relations of noun phrases (\textit{external number and case}).
The ordering of morphological elements is a mirror image of syntactic order, with suffixes closer to the stem reflecting syntactic parts in closer construction with the word concerned and with suffixes more distant from the stem and closer to the word edge reflecting syntactic parts in least close construction with the word concerned.

To carry this principle through in the example above, one could also have expected the middle noun (phrase) to “resume” the PLURAL and NOMINATIVE markers of its own immediate head noun:

\[ \text{ḳ}lîte-n-i \quad \text{sasupevel}-\text{isa}-n-i \quad \text{ca-ta}-\text{jsa}-n-i \]
key-PL-NOM   kingdom-GEN-PL-NOM heaven-PL.OBL-GEN-PL-NOM
'(the) keys of the kingdom of (the) heavens'

But even in Old Georgian there were limits to suffix exuberance.

(More on this topic in *Double Case*, ed. F. Plank, OUP 1995.)
• What is semantically MORE RELEVANT for the stem may come closer to the stem than what is LESS RELEVANT.

For example, tense, in particular preterite, could be considered more relevant for verb meaning in German than information about person and number of the subject: whether an event is taking place now or has taken place before would accordingly be a more important difference between instances of events than the participation in it of the speaker, addressee, or others.

Therefore, tense comes closer to the verb stem than person-number agreement, which comes last and right at the right word edge.

Compare template (i) of Kekchí above:
TENSE/ASPECT – Agent/Subject:PERSON.NUMBER – Stem_{dynamic/Verb}

(More on this topic in Morphology, by Joan L. Bybee, Benjamins 1985.)
• If the meaning/validity of $Y$ somehow depends on $X$ (is in the “SCOPE” of $Y$), then $X$ comes before $Y$ or is closer to the word edge than $Y$.

A hypothetical example: Given the meaning to be expressed in a complex word is 'it is possible for cows that they do not fly', then the negative affix would be closer to the stem than the possibility affix: *cows are fly-un-able or able-un-fly*;
given the meaning 'it is not the case that it is possible for cows to fly', then the possibility affix would have to be closer to the stem than the negative affix: *cows are fly-able-un or un-able-fly*.

Unfortunately, neither English nor German allow us to put this hypothesis to the test, because relevant affixes occur on either side of the stem, equally close or distant: *un-fly-able, un-flieg-bar*.

(More on this topic, as well as the following, in *Morpheme order and semantic scope*, by Keren Rice, CUP 2006.)
That ordering will be preferred which sounds better rhythmically or which can be better syllabified or where the segments in affixes follow an ordering of increasing/decreasing sonority.

Remember from an earlier chapter the prosodic motivations for the internalisation of infixes. (E.g., Latin *ru-N-p-* is easier to syllabify and pronounce than *rup-N-* 'break-PRESENT-'.)

In Western Cherokee (Iroquoian), counterfactual and cislocative prefixes usually come first in personal pronoun forms, but can be re-ordered so as to be inside person-and-number prefixes when thereby a consonant comes to precede a glide and, owing to /i/ deletion, a complex onset cluster results, with the two prefixes fused into one syllable:

\[
\begin{align*}
yi-hi-nega & \rightarrow h-yi-nega & wi-hi-nega & \rightarrow h-wi-nega \\
\text{COUNTER-2SG-person} & & \text{CISLOC-2SG-person} & \\
yi-ji-nega & \rightarrow yi-ji-nega & wi-ji-nega & \rightarrow wi-ji-nega \\
\text{COUNTER-1SG-person} & & \text{CISLOC-1SG-person} &
\end{align*}
\]
• Order is determined historically insofar as it reflects the relative chronology of affixes having become bound to stems: the earlier in the history of a language an erstwhile free meaningful form (an independent word, that is) got bound, the closer it is to the stem, because affixes newly created from independent, but cliticised words are always being added at the word edge, and the lastest additions will therefore occupy the most peripheral slots.

For example, in Swedish verbs the preterite suffix -te is close to the stem and the passive suffix -s comes last:

\begin{itemize}
  \item \textit{Amerika upptäck-te-s} \quad \textit{av Kolumbus}
  \item America discover-PRET-PASS by Columbus
  \item ‘America was discovered by Columbus’
\end{itemize}
The reason:
The dental suffix of the “weak” preterite is an old, Common Germanic suffix, deriving from the verb 'did' combined with the verb and then downgraded to suffix more than 2000 years ago, while the passive suffix -s was only created several hundred years ago in the North/Scandinavian Germanic languages, also derived from an originally independent word, namely the reflexive/middle pronoun sik (lit. 'Amerika entdeckte-sich von Kolumbus').

However, since children acquiring contemporary Swedish will not normally have had a course in historical linguistics, they will not be able to invoke this relative chronology of morphologisation to regulate their affix ordering. They will simply have to learn that TENSE (PRETERITE) comes before DIATHESIS (PASSIVE) – unless there are some other general principles at work here also requiring this particular ordering. (Relevance? Scope? Syntax?)

http://www.archive.org/details/collmathpapers03caylrich
6.2. Hierarchical (“deep”) word structure

• anything else? (final question of introduction of this chapter)

If the answer is “yes”: hierarchical (or “deep”) morphology

Relations relevant for hierarchical word structure:

• (immediately) follow/precede
  [same as in templatic morphology]

• be part of,
  with immediate parts ≠ ultimate parts
  [unlike, and more complex than, in templatic morphology]

• be head-of-a-construction, be dependent.
The crucial difference to templatic/flat structures consists in this:

(\textbf{at least some} \textit{immediate parts} \neq \textit{ultimate parts})

Let a whole $A$ have parts $M, N, O, P, Q, R$.

With \textit{(wholly) flat} structures $A$ consists immediately as well as ultimately of parts $M, N, O, P, Q, R$.

With \textit{deep} structures $A$ may immediately consist of $M$ and $N$, $M$ may in turn immediately consist of $O$ and $P$, $N$ may in turn immediately consist of $Q$ and $R$. $O, P, Q, R$ are here the ultimate constituents, which do not in turn consist of anything else.
Let us examine one kind of evidence for hierarchical word structure – and it needs such evidence, for else one would make simpler assumptions about structures; assuming “flat” morphology (absence of hierarchical structure) is simpler than “deep” morphology.

Classification of morphemes depending on their **combinatorial potentials**:

- what a morpheme combines with;
- what kind of construction the combination results in (with heads determining the kind of construction; see below)
Take one of the above examples of complex words in English, *undecipherability*:

*de-* adds to a noun or a verb, preceding it, and forms a verb from it,
  e.g. *de-throne*, *de-rail*, *de-compose*

*-able* adds to a verb, following it, and forms an adjective from it,
  e.g. *eat-able*, *perish-able*

*un-* adds to an adjective (we're talking about negative *un-*), not reversative *un-*, which latter only adds to verbs: *un-do*, *un-pack*), preceding it, and forms an adjective from it,
  e.g. *un-wise*, *un-able*

*-ity* adds to an adjective, following it, and forms a noun from it,
  e.g. *stupid-ity*, *impossibil-ity*
Is this all true? Or are there sometimes further combining possibilities? (Check: a reverse dictionary will come handy for suffixes. Or take a handbook of English word formation.)

By the way: What does it mean to call words nouns, verbs, adjectives? Answers in Syntax I, under the heading of WORD CLASSES or PARTS OF SPEECH.
What follows from these limited combinatorial potentials for the structure of morpheme combinations (words, morphologically speaking)?

- Such words do not merely consist in (immediate/mediated) sequences of morphs.

- There is a further structure-defining relationship in addition to linear sequence:

  the relationship of being **IMMEDIATE PART OF A WHOLE**
  (or: **BELONGING MORE CLOSELY WITH ONE PART THAN WITH ANOTHER**),
  which adds depth – i.e., hierarchy – to part-whole structures.
To restate what was said above analysing *undecipherability*:

What are the **ultimate** (morphological) parts of *undecipherability*?

☞ the morph(eme)s *un*-, *de*-, *cipher*, *-able*, *-ity*, in this sequence

What are the **immediate** parts, on the evidence of the limited combinatorial potentials of the respective parts?

- of the noun *undecipherability*?
  ☞ the adjective *undecipherable* and the suffix *-ity* (*A\N*)

- of the adjective *undecipherable*?
  ☞ the prefix *un*- (*A/A*) and the adjective *decipherable*

- of the adjective *decipherable*?
  ☞ the verb *decipher* and the suffix *-able* (*V\A*)

- of the verb *decipher*?
  ☞ the prefix *de*- (*V/N*) and the noun *cipher*
Expressed through (annotated/labelled) bracketing:

\[
\left[ \left[ \text{un-}_{A/A} \left[ \left[ \text{de-}_{V/N} \text{cipher} \right]_N \right]_V \text{able}_{V/A} \right]_A \right]_A \text{-ity}_{A/N} \right]_N
\]

with brackets indicating what closely belongs with what, at each hierarchical level (nested brackets):
in constructing this complex word,
  *cipher* belongs more closely with *de-* than with *-able*;
  *decipherable* belongs more closely with *-un* than with *-ity*;
  etc.
Tree of Life, based on completely sequenced genomes
Another, but equivalent representation are constituent structure trees:

```
undecipherability_N
    /        
undecipherable_A      -ity_A\N
    /          
un-A/A      decipherable_A
    /            
decipher_V      -able_V\A
    /              
de-V/N      cipher_N
```
Morpheme combinations (those considered here at any rate) have a **linear** and also a **hierarchical** structure (immediate constituents): a whole consists of immediate parts, and these parts in turn consist of immediate parts, all the way down until the ultimate parts which are not themselves analysable into (morphological) parts.

And there are yet further ways of representing such hierarchical structures other than through bracketing or trees – such as these:
The chart shows how pyramid schemes can become impossible to sustain:

More than the world population
The evidence for hierarchical structures that we relied on in a case such as the complex English word *undecipherability* was the limited combining possibilities of the parts.

Is there any further evidence? For instance, the stepwise construction of complex meanings from simpler meaning components?

Let’s check this with the same example! Is the immediate constituent structure above the only one that is semantically motivated?
What about this alternative?

\[ [\text{un-} [ [\text{de-} [\text{cipher}]_N]\text{V-able}]_A\text{-ity}]_N \]

that is, \textit{un-} combines with a noun to form a noun. Semantically plausible?

cf. \textit{un-employment}, where negative \textit{un-} seems to combine with a noun.

But does Engl. \textit{un-} have a semantics, which enables/allows it to enter combinations with nouns – just as in the case of German \textit{Unsumme}, \textit{Unmenge}, \textit{Unding}, \textit{Unmensch}, \textit{Untier}, \textit{Untat}, \textit{Unzeit}, \textit{Untiefe} (or from \textit{untief}?), \textit{Unfall}, \textit{Unglück} etc.?

Or is \textit{unemployment} more appropriately, if also more abstractly, to be analysed as follows:

\left[ [\text{un-employ(ing)}]_A \text{-ment}\right]_N?
What other evidence is there for immediate constituency? (Like in syntax:) the replacement test

In undecipherability de-cipher can be replaced by something (structurally) equivalent, which, however, is not complex: un-read-ability, hence de-cipher is a constituent;

decipher-able can be replaced by something equivalent, but less complex: un-false-ity, hence decipher-able is a constituent;

un-decipherable can be replaced by something equivalent, but less complex: odd-ity, hence un-decipherable is a constituent.

Could one argue, in this manner, that decipherability is a constituent? Try! (odd-ity, seren-ity, fals-ity, ...
Hierarchical structures aren’t exclusive to morphological constructions; they are also found in syntactic constructions (well, if this is what the evidence suggests: syntax is not necessarily “deep” for all constructions in all languages):

- some **words** may belong together more closely, forming **phrases**;
- some **phrases** in turn may belong together more closely, forming **clauses**;
- some **clauses** may belong together more closely, forming **sentences**;
- some **sentences** may belong together more closely, forming **paragraphs**;

... until we reach the level of a whole **text** or **discourse**.
But hierarchical structures are also found in phonology. Consider syllables.

The simplest assumption about the internal structure of syllables is that it consists in ultimate constituents (segments, ignoring features) being strung out in a sequence – and nothing else.

    e.g. /k – æ – t/

There is some evidence, however, that this assumption is too simple. In most languages, syllables need to be analysed into immediate constituents, the onset and the rhyme, with the rhyme in turn consisting of the nucleus and the coda:

    that is:  [k – [æ – t]]
or:

\[ \sigma \]

- onset
- rhyme

\[ C \quad V \quad C \]

\[ k \quad \text{æ} \quad t \]
Like in morphology and syntax, some parts of syllables belong together more closely than others:

/æ/ and /t/ are closer-knit units than /k/ and /æ/

What is evidence for such hierarchical assumptions? e.g., syllable weight, contributed by exclusively the rhyme, suggesting that the rhyme is a constituent; rhyme in poetry; slips of the tongue, like Spoonerisms such as *queer old dean* for *dear old queen*, implying a division of whole syllables into onsets and rhymes, which are then interchanged:  

\[ d \text{-} ear \ldots qu\text{-}een \Rightarrow qu\text{-}ear \ldots d\text{-}een; \]

...
6.3. Grouping for purposes of pronunciation

It is not only in syntax and morphology that parts are combined to groups, forming parts of larger wholes.

When an utterance is pronounced, phonological parts (= syllables) are also grouped:

( UN ) ( de CI phe ra ) ( BI li ty )

Any other grouping at pronunciation would sound less natural (unmetrical, unrhythmical), and wouldn’t be able to account for certain phonological phenomena based on such groupings – such as word stress, syllabification, assimilations:

*( UN de ) ( CI phe ) ( ra BI li ty )
*( UN ) ( de CI ) ( phe ra BI li ty )
*( UN ) ( de CI phe ra ) ( BI li ) ( ty )

Capitals indicate stressed syllables, with the most prominent syllables in bold.
Such groupings for purposes of pronunciation follow different principles than morphological and syntactic grouping, namely rhythmical ones; morphological and syntactic grouping cannot necessarily be inferred from phonological grouping, and morphological and syntactic grouping do not necessarily determine phonological grouping.
Here is an example of a syntactically and morphologically grouped English sentence:

And here is its most natural phonological grouping:

( ANN ) ( de SPI se sa ) ( HILL bi lly )

or even

( ANN de ) ( SPI se sa ) ( HILL bi lly )

which is the same pattern, and equally anti-morphological/syntactic, as

( UN ) ( de CI phe ra ) ( BI li ty )
Note: Phonological grouping does not seem to know recursive hierarchical structures; the immediate constituents (groups of syllables) are feet, but they do not in turn consist of feet.

In morphology, words (groups of morphs) may consist of words, even words of the very same kind (e.g., blackbird is a noun consisting of a noun plus an adjective). Equally in syntax, phrases (groups of words) may consist of phrases (of the same kind as the containing phrase).

(More on recursion to follow.)
6.4. Heads and dependents in words

Finally, the structural relations of HEAD and DEPENDENT in words.

The HEAD is that part of a construction (a morphological as well as a syntactic construction) which determines the character of the whole (e.g., its word or phrase class), and the other parts are the DEPENDENTS.

To illustrate, let’s once more take the example of *undecipherability*:

- In the construction *de-cipher cipher* is the stem and *de-* is a prefix; the semantically more concrete part is the stem, but the character of the whole is determined not by the stem, but by the prefix: *cipher* is a noun, but *de-cipher* is a verb (it is inflected like a verb, namely for tense and person and number of the subject; being a transitive verb, it takes a direct object) – which is owed to the prefix *de-*, above categorised as a verb, albeit one that requires a noun for completion (V/N).
• In the construction *decipher-able* the head is the suffix: it is owing to this suffix that *decipher-able* is an adjective (it can be used as attribute or predicate; it can be modified by adverbs; it doesn’t inflect for tense and person and number of the subject), while *decipher* is a (transitive) verb; accordingly this suffix -*able* is above categorised as an adjective, albeit one that requires a verb for completion (V\A). (Which fits in well with the history of suffix -*able*, unmistakeably deriving from the independent adjective able: *someone is able to decipher something* – *something is decipherable*.)

• In the construction *un-decipherable* it is less clear what is head and dependent: the whole is an adjective, but *decipherable* itself is an adjective and prefix *un-* doesn’t alter this word class (as little as the independent negation word *not* would alter it, an ad-adjective, sometimes called an adverb).
• In the construction *undecipherabil-ity* it is again clearly the suffix which is the head: the whole is a noun (takes an article and other determiners; has adjectives rather than ad-adjuncts as modifiers; inflects for number, and not for tense nor is it gradable), and this is due to suffix *-ity*, which is therefore categorised as A\N, as a noun which requires an adjective (such as *decipherable*) for completion.
In cases of templatic, “flat” morphology, like those considered above, headedness seems to be a wholly different matter.

It seems that there are no such character changes of the whole relative to its parts in such templates. Instead, there was always a **semantic core** constituent (a predicate, of the word class verb, adjective, or noun), and the whole complex word was always of the same kind as that core.

The affixes involved, however, may be characteristic of particular word classes (e.g., tense, mood, person and number are only found in verbal templates in German), and they may on such grounds resemble heads in hierarchical word structures.

But headedness is a very difficult concept in morphology ...
Homework:

Check whether in clearly hierarchical word structures heads come consistently either before or after their dependents throughout all kinds of complex words of a language, say of English or German. Or do some (kinds of) complex words have their heads in initial position and other (kinds of) complex words in final position?

Reading: