

Rethinking Linearisation

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Leipzig, 23 May 2009

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- Derivation of linear structure from hierarchical structure.
- Is this sufficient?
- Is it really the right way to look at it?

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- To look a bit more closely at “linear” structure.
- To sketch a model of linearisation in terms of the mapping from syntax to phonology.

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Standard approaches to linearisation in generative syntax make two fundamental assumption:

- Totality
- Linear Correspondence

(Cf. *Exclusivity Condition* and *Nontangling Condition*, Partee et al. 1993.)

Additionally, there is the belief that linear order is *all* that needs to be accounted for.

Totality

Every terminal node in the tree has a unique position in the linear sequence.

In the formulation of Kayne (1994):

- (1) Given a tree K and the set T of terminals in K :
- $$\forall x, y (x, y \in T \wedge x \neq y \mid x < y \vee y < x).$$

where $x < y$ means ' x precedes y '.

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If two elements are sisters in the tree, they are adjacent in the linear string.

Formalised by Ackema and Neeleman (2004) (cf. Kremers 2007):

(2) Linear Correspondence:

If a node X is structurally external to a node Y , then $\Phi(X)$ is linearly external to $\Phi(Y)$.

where Φ is the linearisation function.

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Both assumptions are problematic:

- (3) with effort *DGS*
STUDENT SIGN-LANGUAGE LEARN
'The student learns SL with difficulty.'
(Leuninger 2005)
- (4) anxiously *DGS*
CLOSET_a CAT_b WALK-ABOUT:Cl_b:Loc_a
'A cat is walking about anxiously on the closet'

Some data

It is also possible for both hands to realise different signs simultaneously:

- (5) **hd:** *not* *NGT*
rh: CUT
lh: NOW
'Don't interrupt me now!'
(Miller 1994)
- (6) **rh:** BOY——— *BSL*
lh: SMALL
'a small boy'
(Kyle and Woll 1985, 157)

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What about question formation through intonation?

(7) $\overline{\text{tu}} \text{ sais } \text{danser?}$
you know dance
'do you know how to dance?'

French

Or case marking through tone?

(8) a. $\acute{\epsilon}\text{-d}\acute{o}l \text{ } \acute{\epsilon}\text{mb}\acute{\alpha}\text{rt}\acute{\alpha}$
3-sees horse.ACC
'the horse sees him'

b. $\acute{\epsilon}\text{-d}\acute{o}l \text{ } \acute{\epsilon}\text{mbart}\acute{\alpha}$
3-sees horse.NOM
'he sees the horse'

Maasai

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- There is more going on than just the lining up of terminal elements.
- Sometimes elements are superimposed.

Questions:

- What types of elements can be superimposed?
- What is the relation between the two elements?

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Elements that can be superimposed:

- Functional elements (K° , $C^\circ[+wh]$, also Neg°)
- Adverbials
- Adjectives (at least persevered)

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It seems that arguments can also be superimposed:

(9) CLOSET_a WALK-ABOUT:Cl_{animal}:LOC_a *DGS*
'It is walking about anxiously on the closet'

(10) **m: push** *BSL*
h: BOAT
'push the boat'
(Sutton-Spence 2007)

Questions

What is the relation between the two superimposed elements?

Complement	F°
V	AdvP
Predicate	Argument
(Noun)	(Modifier)

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- Very little can be said about the semantic relation.
 - Pred-Arg
 - Verb-Adjunct
 - Negation-Clause
 - ...

- All that can be said is that there is *some* semantic relation.

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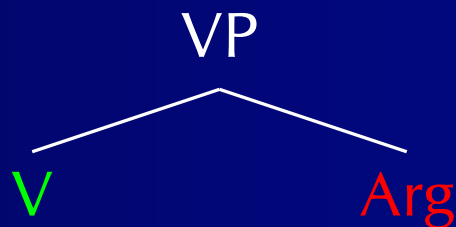
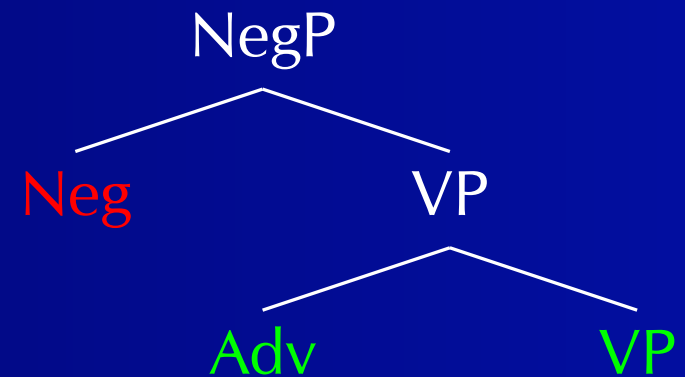
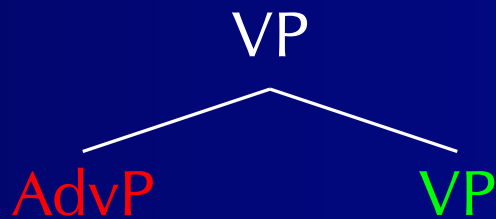
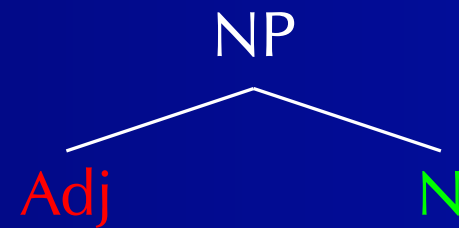
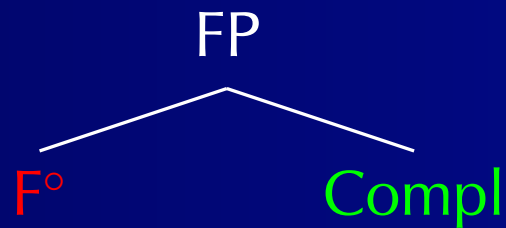
Conclusions

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- At least one of the simultaneously realised elements must be segmental.
- The other element(s) can be segmental or non-segmental.
- That seems to be about all that can be said.

Structural relations

Green = segmental, red = non-segmental.



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- The elements realised simultaneously are structurally related, but not in a consistent way:
 - Either may project.
 - Either may be a head.

- At best, we can say that both elements must be *sisters*.

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(1) Given a tree K and the set T of terminals in K :
 $\forall x, y (x, y \in T \wedge x \neq y | x < y \vee y < x)$.

Totality is an inadequate descriptive generalisation. It is certainly *not* a guiding principle in linearisation.

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What about Linear Correspondence?

(2) Linear Correspondence:

If a node X is structurally external to a node Y , then $\Phi(X)$ is linearly external to $\Phi(Y)$.

This appears to be incorrect as well, since it is violated by every simultaneity example we have seen.

However, it may nonetheless play a role in linearisation.

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Elements can be realised simultaneously. The requirements for simultaneity are:

- Two or more phonological chunks on different *tiers*.
- A sisterhood relation.

Yet, we know that items are (usually) linearly ordered.

- In principle, the linearisation procedure attempts to express the (non-ordered) sisterhood relation *directly*.
- If this is not possible, a linear ordering is chosen instead, obeying LC.

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- Linear order is a strategy of the phonological system.
- We will need some form of ordering parameters (head parameter).
- Crucially, such parameters are *phonological* in nature.
- That is, there can be no reference to linear order in syntax.

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Derivation of phonological structure involves more than just linearisation.

- Phonological structure consists of a number of autonomous *tiers* (Goldsmith 1976).
- Syntactic elements are associated through mapping rules with phonological material (Jackendoff 2002, Ackema and Neeleman 2004):

$$(11) \quad \text{MAN}_{\langle e,t \rangle} \leftrightarrow \begin{bmatrix} \text{N, sg} \\ \text{count} \end{bmatrix} \leftrightarrow /mæn/$$

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- The various phonological chunks that the mapping rules produce must be assembled into a phonological structure.
- Required principles:
 - Simultaneous realisation of sister nodes
 - If this fails: LC + ordering parameters
 - Left-to-Right Association (and language-specific exceptions)

An example: Sign language

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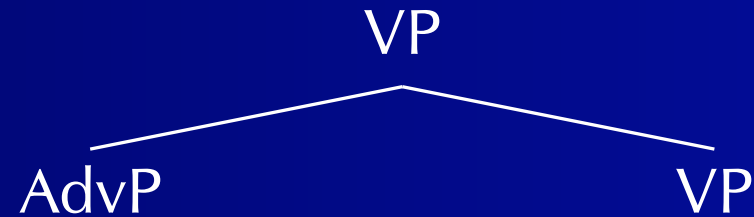
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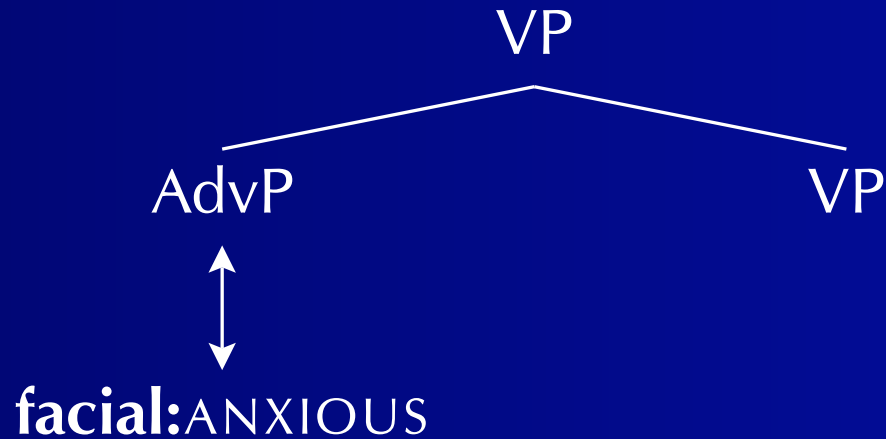
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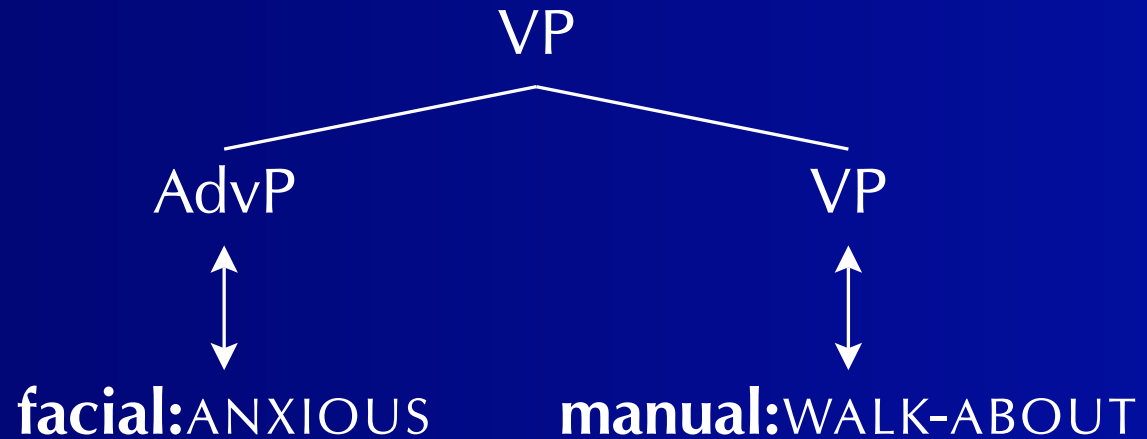
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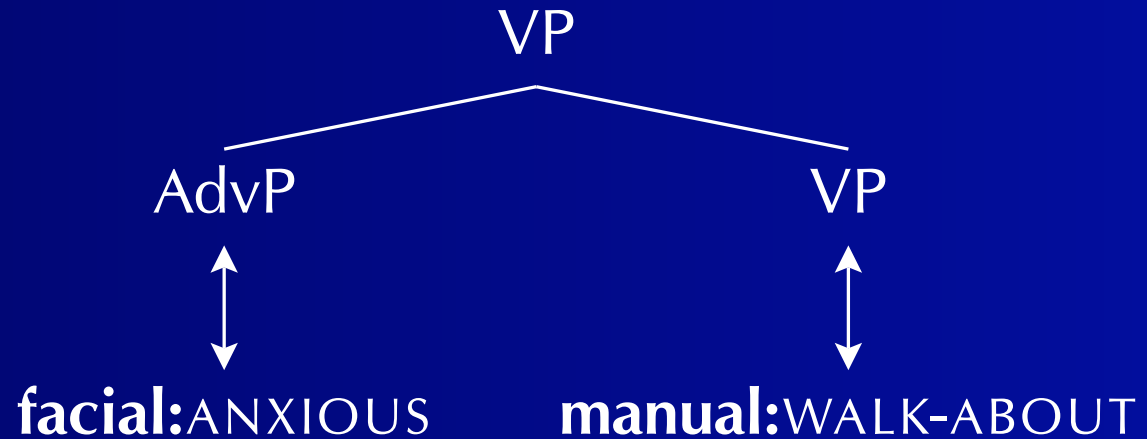
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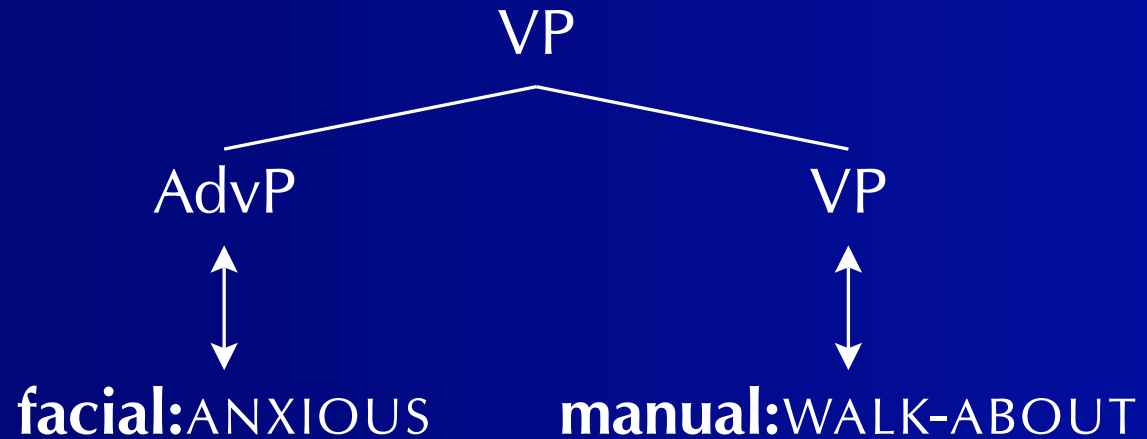
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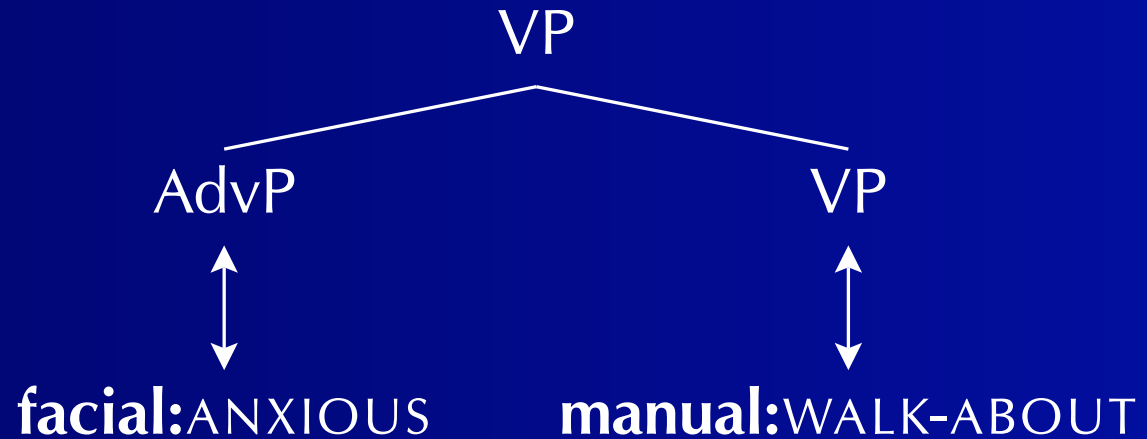
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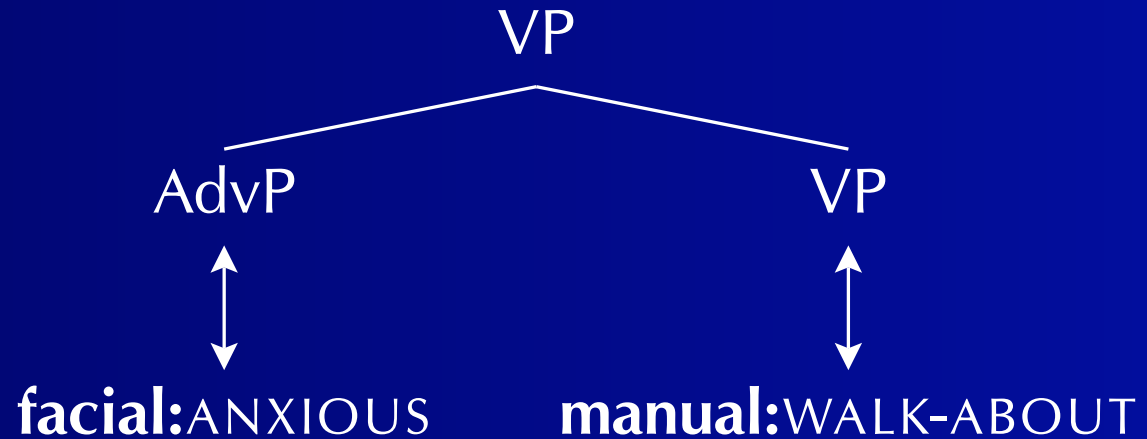
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facial:	ANXIOUS
manual:	WALK-ABOUT

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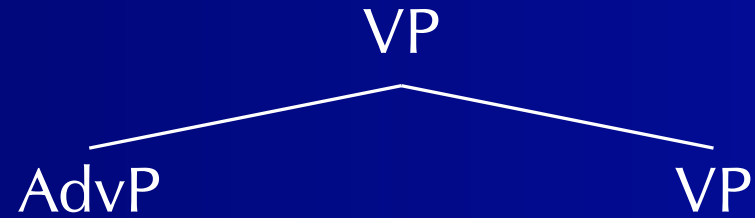
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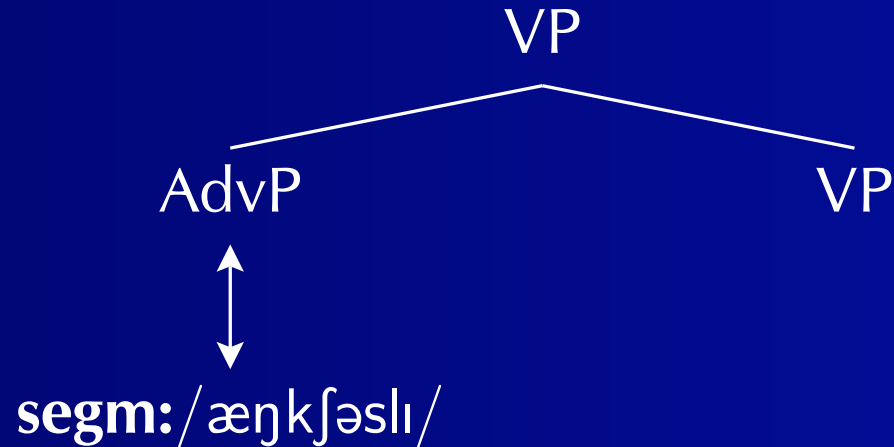
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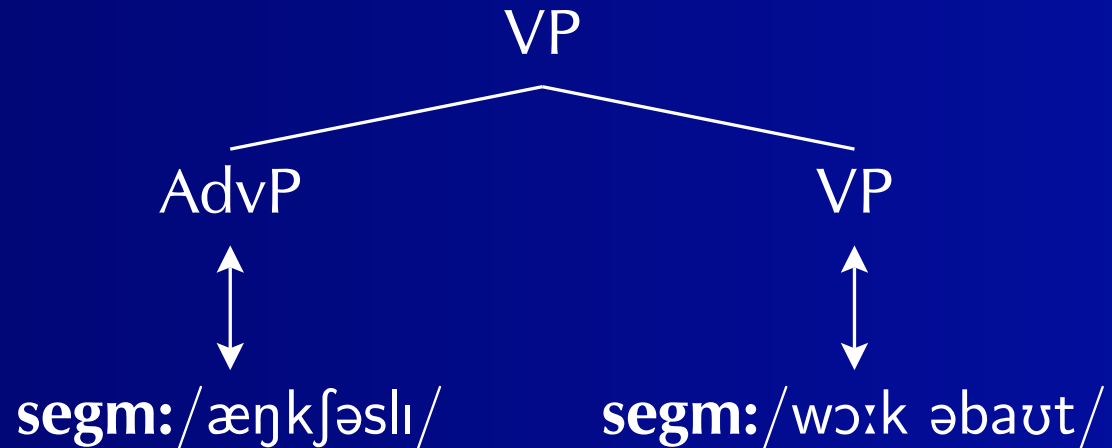
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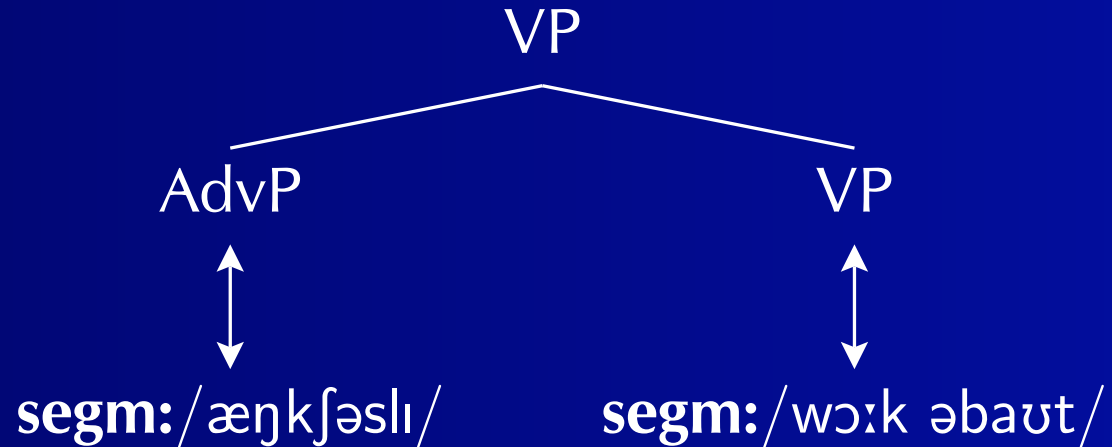
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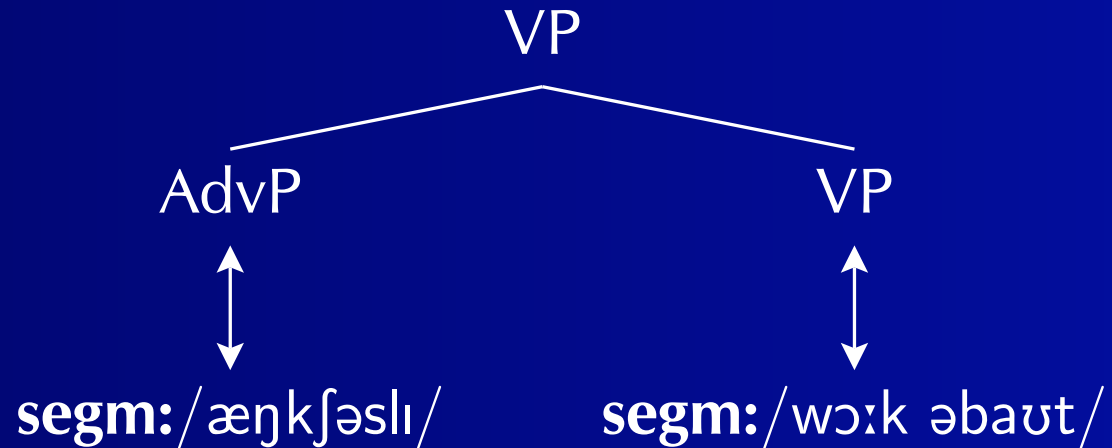
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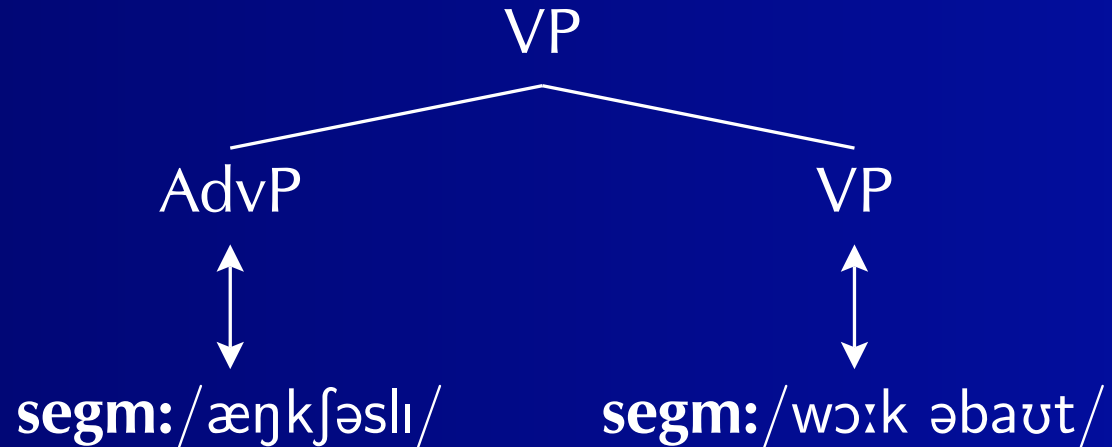
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/wɔ:k əbaʊt/

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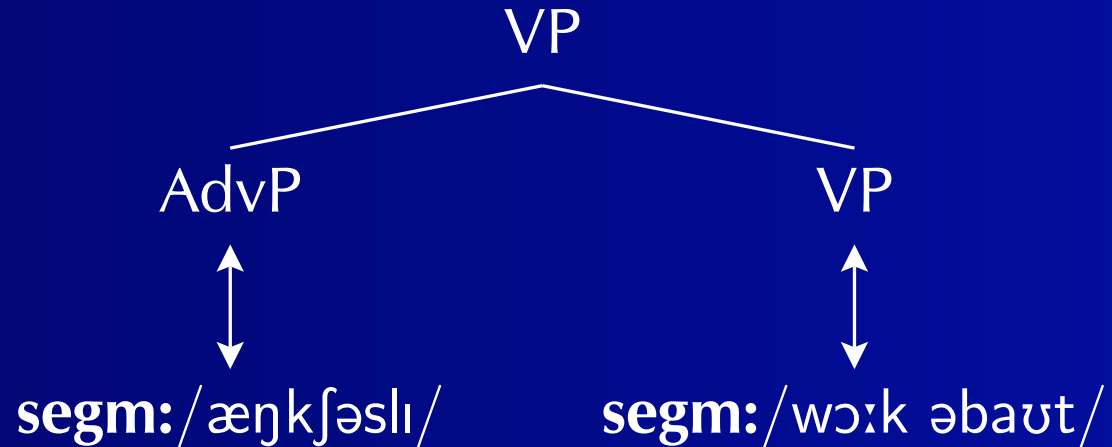
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Prosodic hierarchy

Phonological structure contains a hierarchy of *prosodic constituents*:

Utterance (U)

Intonational Phrase (IntP)

Phonological Phrase (φ)

Prosodic Word (ω)

Foot (Ft)

Syllable (σ)

Mora (μ)

(cf. Nespor and Vogel 1986)

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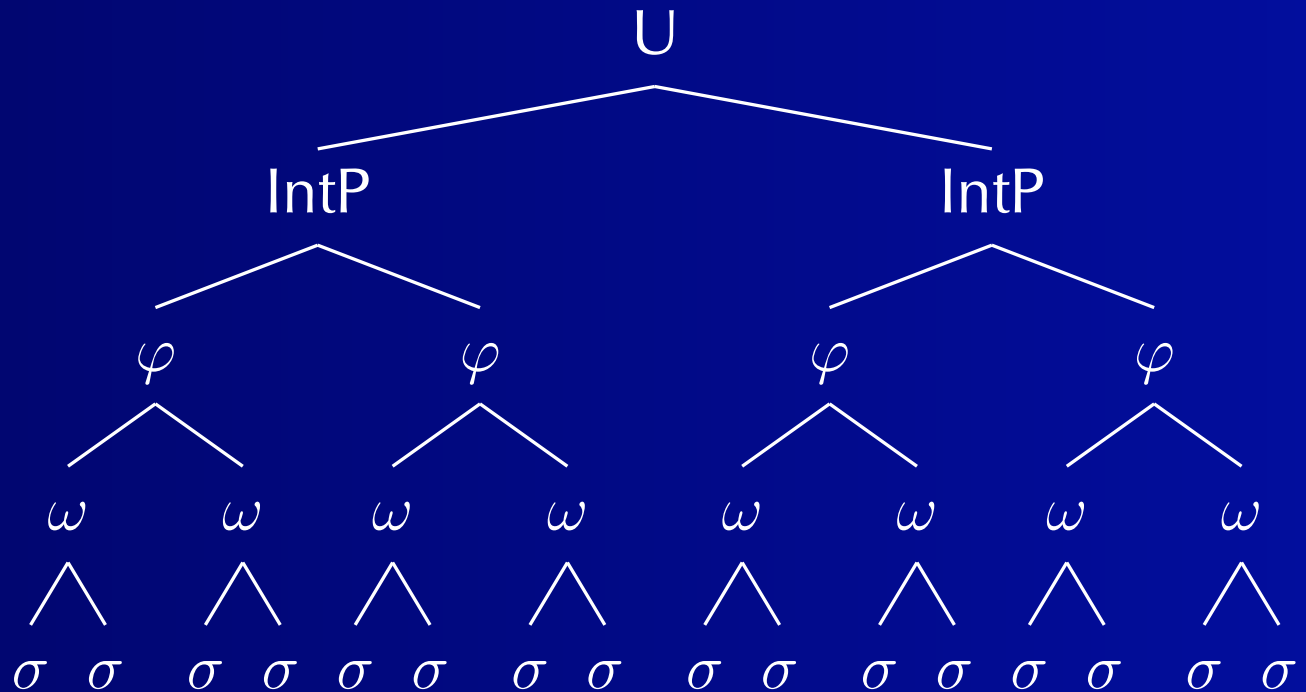
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In e.g. Arabic, prosodic structure is morphological (cf. McCarthy and Prince 1990):

Perfective stem	Deverbal noun
ʔaktab	ʔiktāb
inkatab	inkitāb
iktatab	iktitāb
iktabb	iktibāb
istaktab	istiktāb
iktātab	iktītāb
iktawtab	iktiwtāb
iktawwab	iktiwwāb
iktabab	iktinbāb
iktabay	iktinbāy

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Form: ⁱktitāb

root:	/ktb/	nominaliser:	/i a/
stem VIII:	(σ)σ _μ	non-finite:	σ _{μμ}
	t		

syllabic tier

segmental tier

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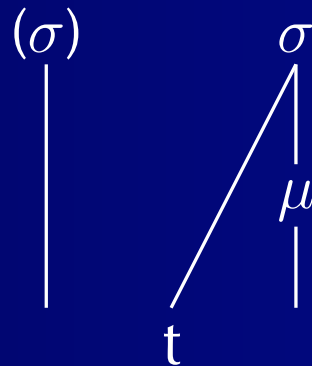
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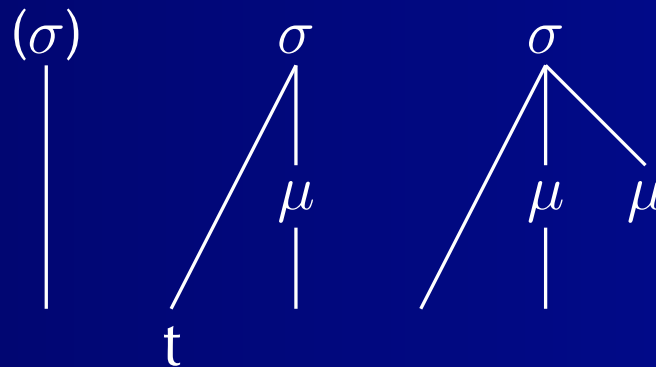
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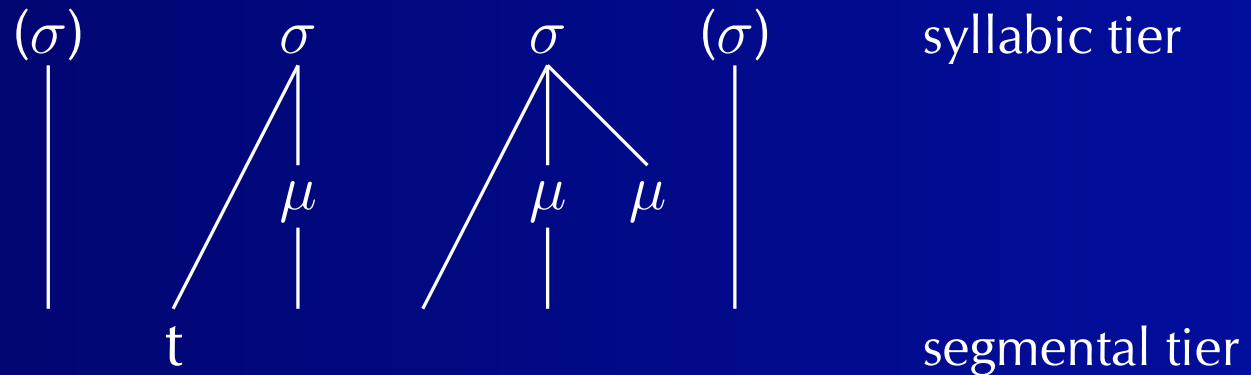
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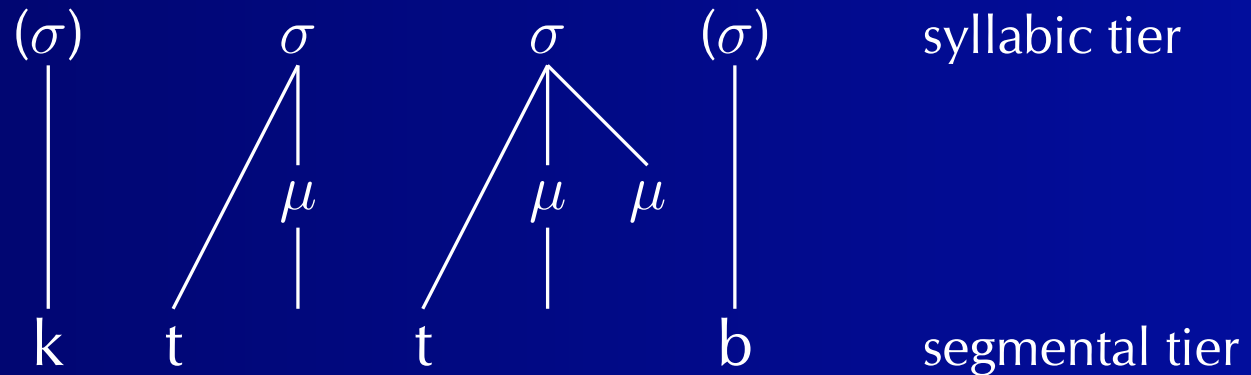
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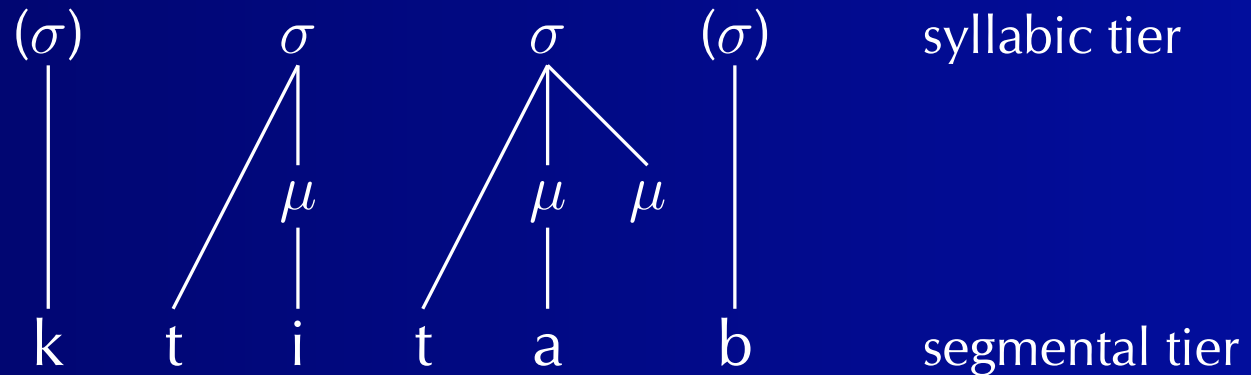
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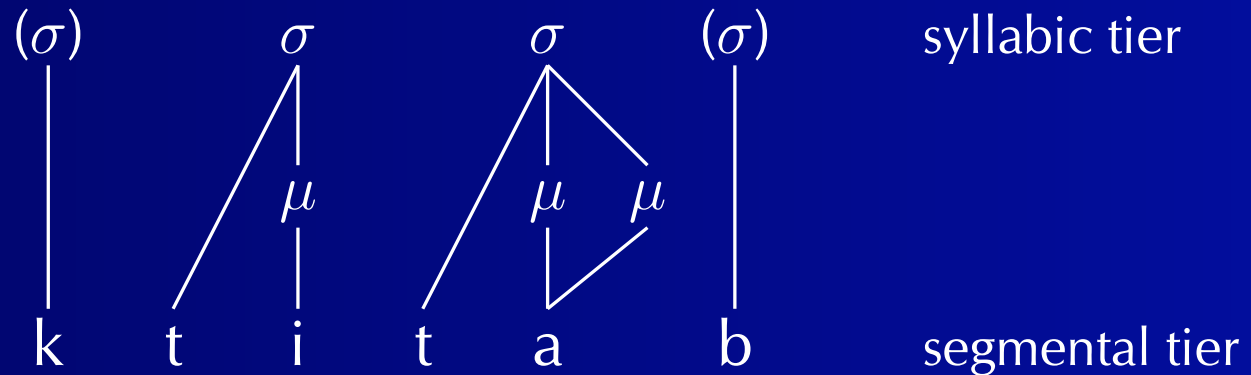
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Form: ⁱktitāb

root:	/ktb/	nominaliser:	/i a/
stem VIII:	(σ)σ _μ	non-finite:	σ _{μμ}
	t		



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- The morphological structure of Arabic deverbal nouns can be described by means of a syntactic tree.
- The linear order of the segments is determined by the *prosodic* structure.

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- The morphological structure of Arabic deverbal nouns can be described by means of a syntactic tree.
- The linear order of the segments is determined by the *prosodic* structure.

Proposal: Prosodic structure is relevant for the linearisation of *syntactic* structures as well.

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For example:

Standard correspondence rules between syntax and phonology (Selkirk 1984, Nespor and Vogel 1986, Truckenbrodt 2007):

(12) WRAP-X: A syntactic head must be wrapped in a prosodic word.

$$\text{CAR} \leftrightarrow \begin{bmatrix} \text{N, sg} \\ \text{count} \end{bmatrix} \leftrightarrow /ka:r^d /_{\omega}$$

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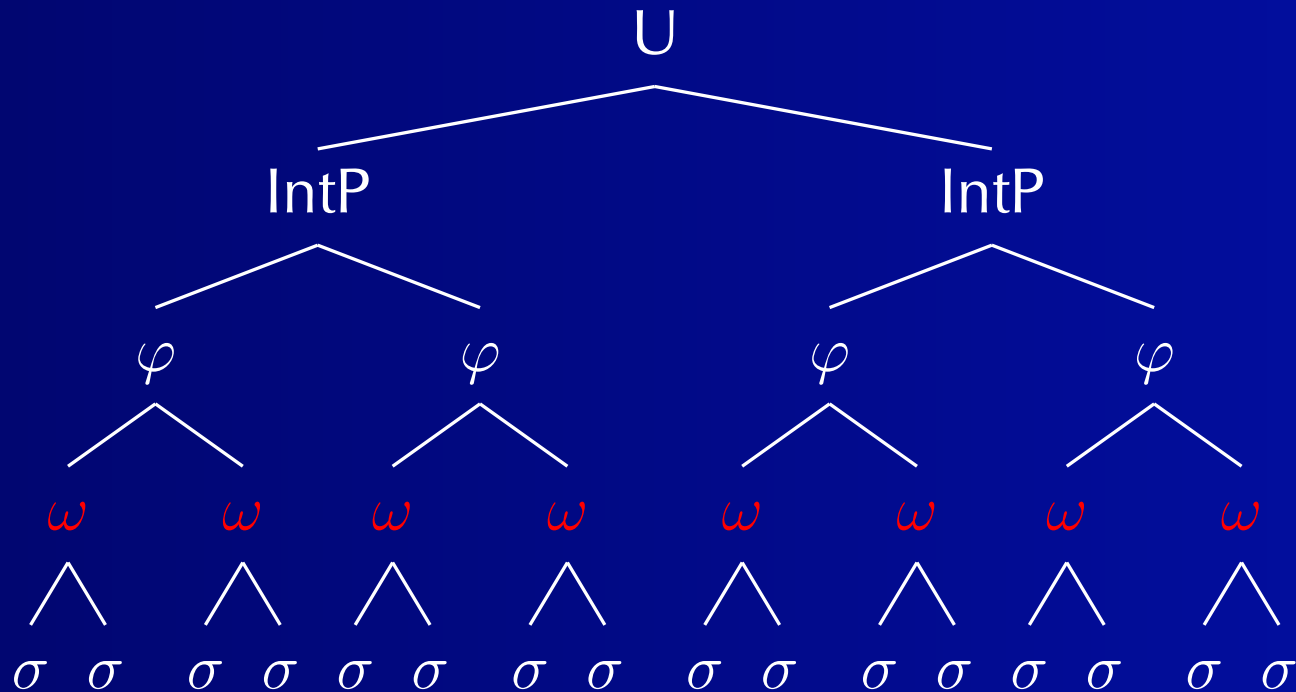
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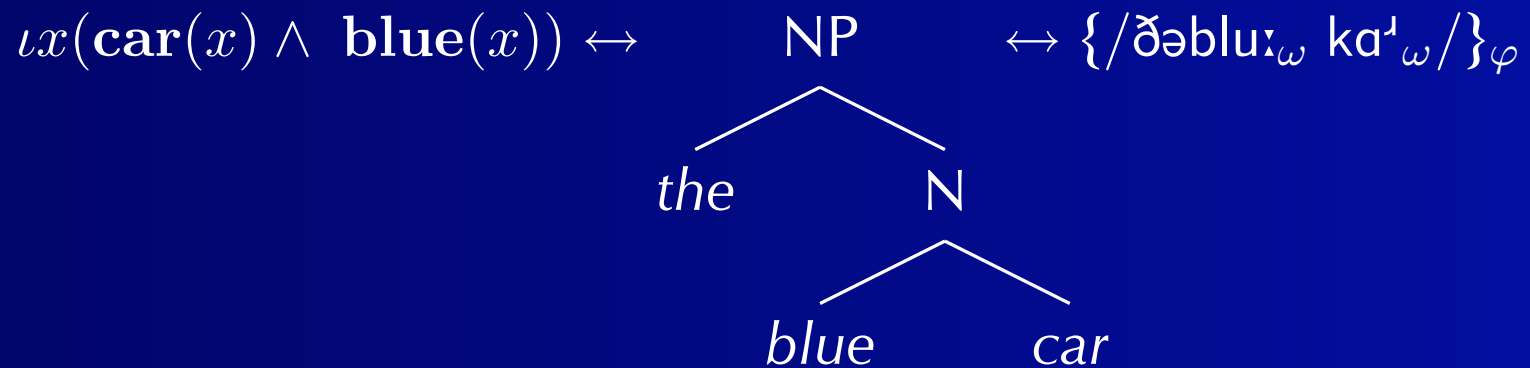
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(13) WRAP-XP: a syntactic phrase must be wrapped in a phonological phrase.



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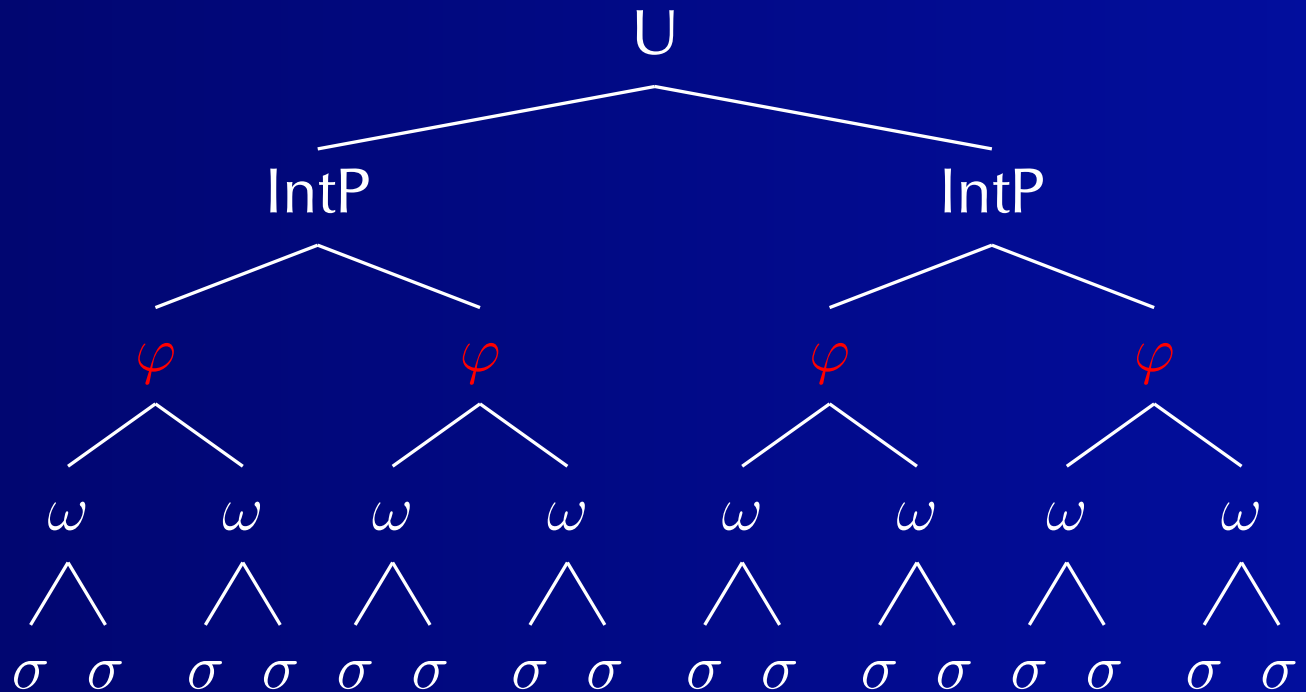
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Ordering I: Specifiers

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- Specifiers are XPs and are therefore subject to WRAP-XP.
- The sister of a specifier is an intermediate projection and is irrelevant to phonology.
- Suggestion: For this reason, specifiers tend to be linearised to the left: the phonological system deals with them first, and only deals with the head and complement in a subsequent step.

Ordering II: Adjuncts

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- As Truckenbrodt (1995) shows, the two-segment XP in an adjunction structure is prosodically irrelevant.
- Adjuncts are maximal projections and therefore subject to WRAP-XP.
- The sister of an adjunct is also a maximal projection subject to WRAP-XP.
- Because of this reason, there is order variation among adjuncts: Adv-V vs. V-Adv, Adj-N vs. N-Adj, etc.

Ordering III: Complements

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- Complements are XPs and are therefore subject to WRAP-XP.
- The sister of a complement is a head and therefore subject to WRAP-X.
- As with adjuncts, the fact that both sisters are subject to mapping rules means ordering variation exists.

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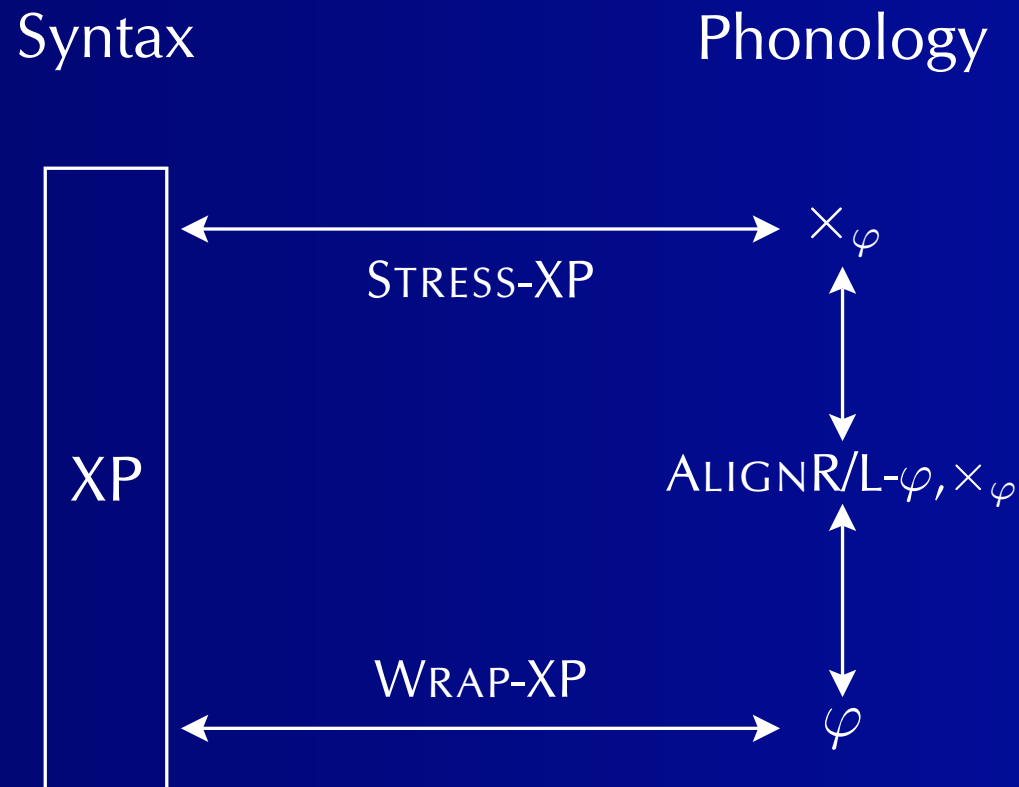
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Stress Alignment:

- STRESS-XP: Every syntactic phrase has φ -stress.
- There is a correlation between the alignment of stress and the directionality of head-complement structures:
 - head-initial \leftrightarrow φ -final stress (“read the **book**”)
 - head-final \leftrightarrow φ -initial stress (“das **Buch** lesen”)

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Truckenbrodt (1995) proposes a *phonological* rule that aligns the right/left edge of a φ with stress:



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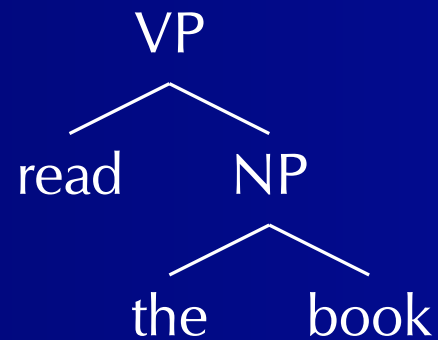
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For Truckenbrodt, linearisation is syntactic, so that before application of $ALIGNR/L-\varphi, \times_{\varphi}$, the relevant structure is already linearised:



	WRAP-XP		STRESS-XP	
$/ri:d \ \delta\theta'b\text{ʊ}k/\varphi$	✓VP	✓NP	✓VP	✓NP
$/'ri:d \ \delta\theta b\text{ʊ}k/\varphi$	✓VP	✓NP	✓VP	*NP

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- For Truckenbrodt, linearisation is a given. But do we really need to assume this?

	WRAP-XP	STRESS-XP	ALIGNR- φ, X_φ
/ri:d ðə'bʊk/	✓VP ✓NP	✓VP ✓NP	✓
/'ri:d ðəbʊk/	✓VP ✓NP	✓VP *NP	*
/ðə'bʊk ri:d/	✓VP ✓NP	✓VP ✓NP	*
/ðəbʊk 'ri:d/	✓VP ✓NP	✓VP *NP	✓

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- WRAP-X, WRAP-XP, STRESSXP and ALIGNR/L are all constraints from OT-style analyses.
- A reformulation as mapping rules is not always straightforward.

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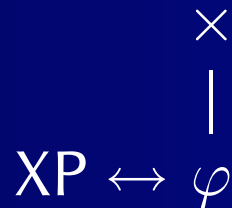
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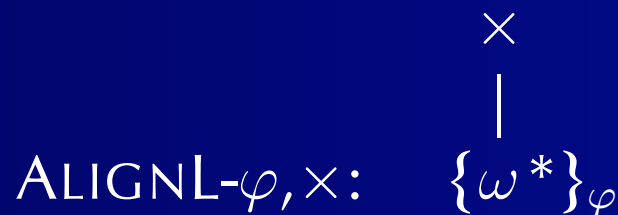
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- STRESSXP is rather simple:



- ALIGNR/L- φ, \times is a purely phonological requirement without syntactic (or semantic) associate:



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The only way to represent WRAP-X and WRAP-XP is as follows:

- (14) a. WRAP-X: $X \leftrightarrow \omega$
b. WRAP-XP: $XP \leftrightarrow \varphi$

This, however, is not exactly equivalent to Truckenbrodt's WRAP-XP:

- (15) $[_{VP} \text{ read } [_{NP} \text{ the book }] \leftrightarrow /rɪ:d \text{ ðə'bu:k}/\varphi$

(15) satisfies the original WRAP-XP for the NP, but it does not satisfy the reformulation in (14b).

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In the linearisation of [read [the book]], several rules apply:

(16) Lexical Rules:

a. $V \leftrightarrow \text{rixd}_\omega$

b. $N \leftrightarrow \text{bʊk}_\omega$

c. $D \leftrightarrow \text{ðə}_\sigma$

(17) Wrapping and Stress:

a. $V, N \leftrightarrow \omega$

b. $VP, NP \leftrightarrow \varphi$

×
|

(18) Alignment:

×
|
{* ω } φ

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- All rules apply simultaneously.
- Obviously, a conflict arises: if VP corresponds to a φ , NP cannot do so at the same time.
- We need some form of conflict resolution.

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φ

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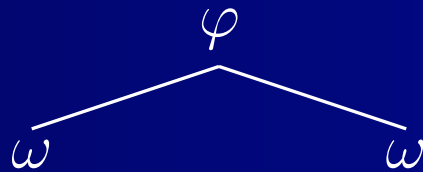
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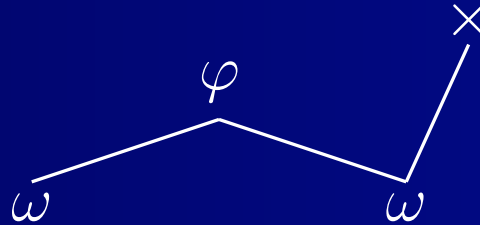
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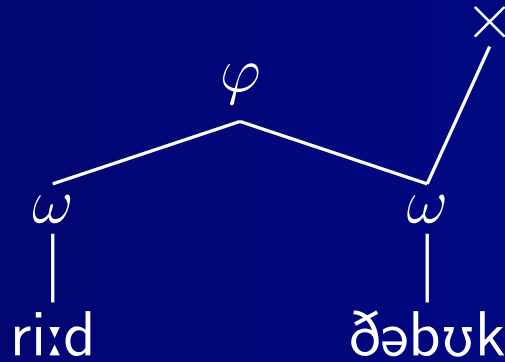
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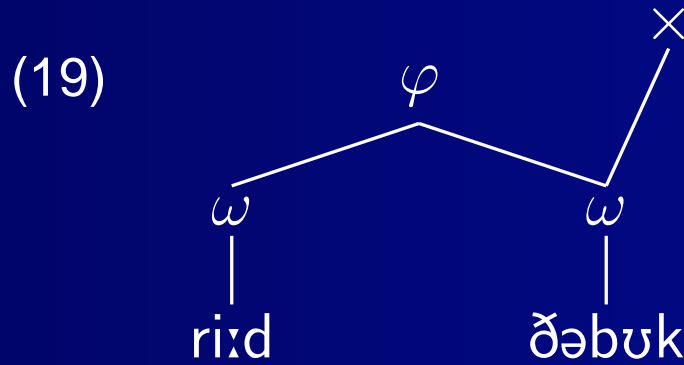
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- In (19), $VP \leftrightarrow \varphi$ applies, while in (20), $NP \leftrightarrow \varphi$ applies.
- In (19), the Alignment rule in (18) also applies, which strengthens the application of $VP \leftrightarrow \varphi$.
- In (20), Alignment does not apply, i.e., the structure is essentially not linearisable.

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Proposal:

- Specific (applications of) rules can strengthen or inhibit each other.
- Alignment in (18) strengthens $VP \leftrightarrow \varphi$, so that (19) wins out.

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- Rules exist as mapping rules, connecting chunks of semantic, syntactic and phonological structure.
- A rule need not link chunks of structure in all three modules. It may link just two, or even just one.
- Any principle that cannot be expressed as as a piece of structure cannot be expressed as a mapping rule.
- E.g., no mapping rule can state that something is *not* allowed.

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- Linearisation is not a simple matter of lining up the terminal elements.
- In essence, the phonological component attempts to retain the unorderedness (simultaneity) of sisterhood.
- When this fails (which is most of the time) an alternative strategy is used: linearisation.
- Linearisation is therefore a purely phonological phenomenon.

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- The direction of linearisation must therefore also be determined purely phonologically, or in the mapping from syntax to phonology.
- Mapping rules link chunks of structure.
- On the phonological side, all chunks must be incorporated into a licit structure.
- Rules may strengthen or inhibit each other.

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