An introduction of recursion in Syntax and (mis)mappings to Phonology

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Roadmap

- Fundamentals of recursion in Syntax
- Mapping to Phonology and independent processing therein
- Restricted recursive effects in phonology

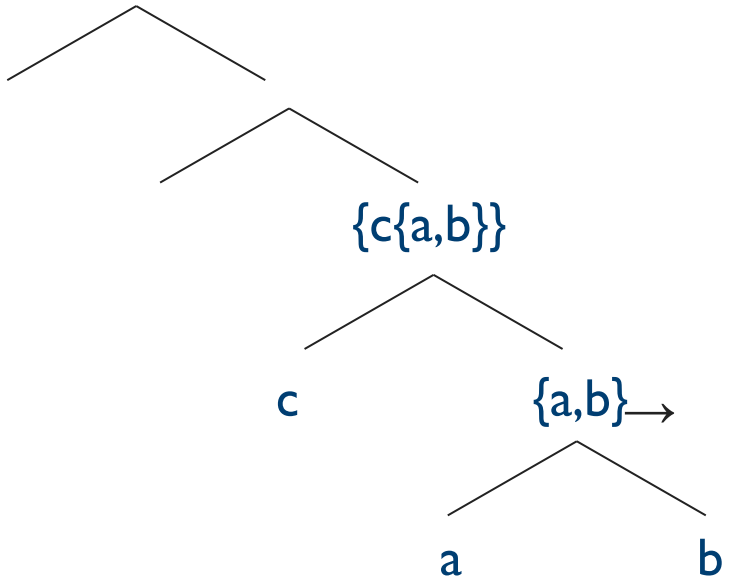
Merge

Merge (Chomsky, 1995, 2000 and much subsequent work) is the minimax function for structure building (Roberts and Watumull, 2015).

Merge {a, b}={a, b}

Merge {c, {a, b}}={c, {a, b}}

….



Syntactic recursion

Recursion is a property of the generative process.

Watumull *et al.* (2014):

- Computability: procedural, dynamic instead of set-taking
- Definition by induction: output → input and repeat
- Mathematical induction: theoretical unboundedness, infinite production.

Brookshear (2007) and Karlsson (2010):

- A recursive function tests for its own termination condition

Cycles

Merge can be stopped by arbitrary factors (Watumull *et al.*): memory, exhaustion of input etc., forming computation cycles: DP/VP/CP/PP etc. (see Boskovic 2014; cf. Chomsky 2001, a.o).

A cycle will be sent to the interfaces (Spell-Out), no further access by syntax. Phonological Forms: SHOWTIME.

Cycles

Assuming cyclic spell-out (Uriagereka, 1999) (Timing varies cf. Chomsky 2001; Boskovic, 2016; Gallego 2007):

[CP This is [DP the cat [CP that
[VP caught [DP the rat [CP that
[VP stole [DP the cheese]]]

→

[the cheese]
T<PAST> [steal [the cheese]
[that [stole [the cheese]]]
[the rat [that [stole [the cheese]]]
.....
[This is [the cat [that [caught [the rat [that [stole [the cheese]]]]]]]]

Syn->Phon

Recursion by inheritance?
NO. Much more complex!

Recursion in phonology?

- *There is no doubt that recursion exists in syntax, but whether this is reflected in prosody is still an open question.* (Féry & Schubö, 2010)

- "Phonology has no recursion" (Idsardi, 2018)
- "a crucial distinction between the syntactic and phonological components of grammar: the former characterized by recursion and the latter not" (Vogel, 2012)

Recursion in prosody

- Each level of the hierarchy of prosodic domains can be repeated (F&S 2010)

- Linear → **iteration** (Nespor&Vogel, 1986; Liberman&Pierrehumbert, 1984)
  - The same level of embedding (Pierrehumbert & Beckman 1988)
  - (*Anna ran some errands and bought*) [*a bottle of orange juice*]P, [*an apple*]P, [*sugar*]P, [*butter*]P, [*a pair of socks*]P . . . .

- Contained within each other → **recursive structure**
  - "Embedding a constituent in a constituent of the same type" (Pinker and Jackendoff 2005, cited by Vogel 2012)."

Prosodic domains

Motivation for prosodic domains:

- Phonological rules do not always apply in morphosyntax-defined domains
  - Linking-*r* and intrusive-*r* in Received Pronunciation (Gimson 1970)
    a. clear + est → clea[r]est
    b. gnaw + ing → gnaw[r]ing
    c. That type of spider is dangerous. → …spide[r]is…
    d. Try that sofa. It's softer. → …sofa[r]It's
    e. There's my brother. I have a cold. → …*brothe[r]I…
    f. Try that sofa. It's after midnight. → …*sofa[r]It's…

Within words

Across words

Prosodic domains

Motivation for prosodic domains:

- Non-correspondence between syntactic constituents and domains of intonation contours
  - In complex sentences with restrictive relative clauses, "the intonation breaks are ordinarily inserted in the wrong place" (Chomsky 1965)
  - This is [the cat that caught [the rat that stole [the cheese]]] syntax
  - [This is the cat] [that caught the rat] [that stole the cheese] prosody
- Flexibility in intonation domains
  - [The frog] [ate a fly] [for lunch]
  - [The frog] [ate a fly for lunch]
  - [The frog ate a fly for lunch]

Prosodic Hierarchy

- Prosodic Hierarchy (Selkirk 1980; Nespor & Vogel 1986)
  - Indirect reference: syntax → prosodic structures → phonetic correlates
  - Determined by syntax but not identical to it
  - An example (cited from Féry 2017: Ch.3)

Interface with other components of grammar	υ	Utterance	(corresponds roughly to a paragraph or more)
	ι-phrase	intonation phrase	(corresponds roughly to a clause)
	Φ-phrase	prosodic phrase	(corresponds roughly to a syntactic phrase)
	ω-word	prosodic word	(corresponds roughly to a grammatical word)
No interface	F	Foot	(metrical unit: trochee, iamb…)
	σ	syllable	(strings of segments: CV, CVC, …)
	μ	Mora	(unit of syllable weight)

Strict Layer Hypothesis (SLH)

- Strict Layer Hypothesis (Nespor & Vogel 1986)
  - Principle 1. A given nonterminal unit of the prosodic hierarchy, Xp, is composed of one or more units of the immediately lower category, Xp–1.
  - Principle 2. A unit of a given level of the hierarchy is exhaustively contained in the superordinate unit of which it is a part.

Strict Layer Hypothesis (SLH)

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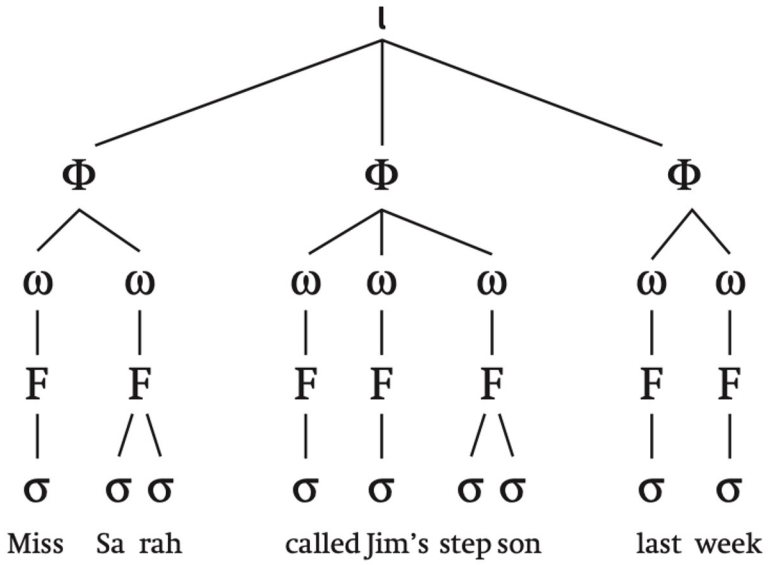
  - Principle 2. A unit of a given level of the hierarchy is exhaustively contained in the superordinate unit of which it is a part.
  - An example of exhaustive parsing (Féry 2017)



U		Utterance
IP	(ι)	Intonation phrase
PPh	(φ)	Phonological Phrase (= p-phrase)
PW	(ω)	Prosodic Word
F		Foot
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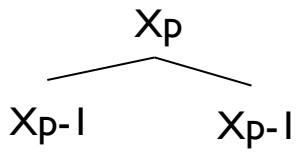
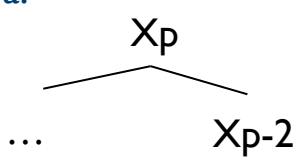
Permitted structure



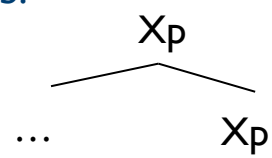
Excluded structure

a.



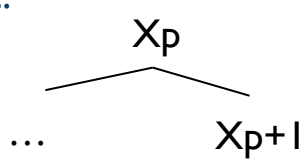
skipping level

b.



recursion 1

c.



recursion 2

Strict Layer Hypothesis (SLH)

U		Utterance
IP	(ι)	Intonation phrase
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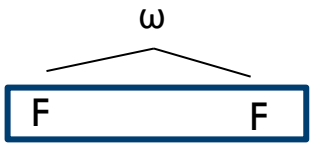
Permitted structure



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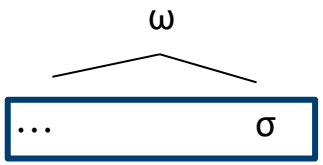

skipping level

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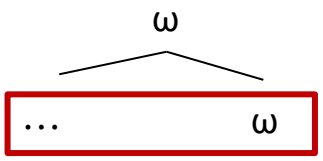

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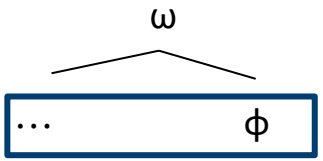
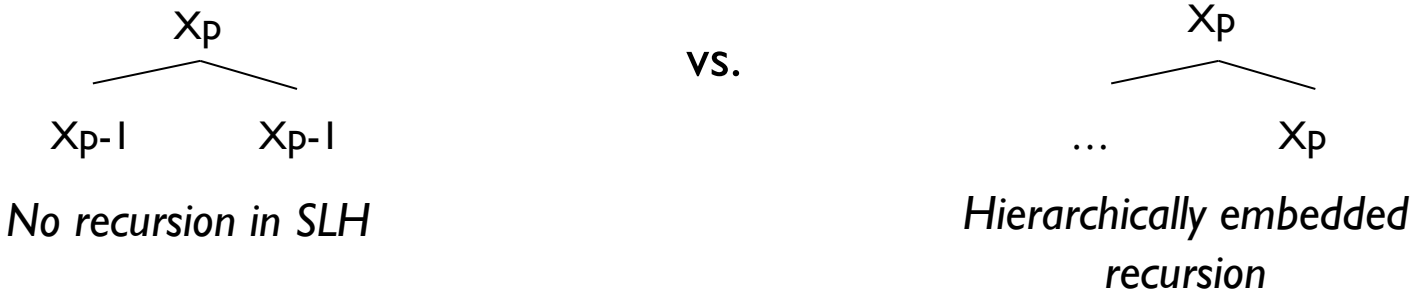


recursion 2

Strict Layer Hypothesis (SLH)

- Strict Layer Hypothesis (Nespor & Vogel 1986)
  - Recursive structures are not permitted in prosody
  - Prosody has a relative flat and simple structure compared to morphosyntax

From SLH to Recursion



- "Embedding a constituent in a constituent of the same type" (Pinker and Jackendoff 2005: 211)."

→ Recursive structures need to be identical in domain and phonological properties.

Usually relaxed

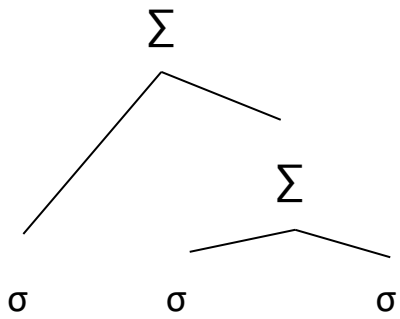
Main sources of recursion in phonology (van der Hulst 2010; Vogel 2019):

1. Used to incorporate stranded units. → recursion in lower levels
2. To avoid the proliferation of prosodic categories. → recursion in higher levels

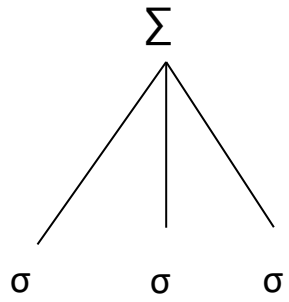
Recursion in lower-level prosodic structures

To incorporate stranded units

- Recursive foot (Vogel 2019):
  - accounts for ternary stress and delimit a domain for ternary tone spreading (Martínez-Paricio & Kager 2021),
  - while maximally binary branching feet can be maintained:



Recursive Foot



Ternary Foot

Recursion in higher-level prosodic structures

To avoid the proliferation of prosodic categories

- The concern of proliferation:
  - Each prosodic category is instantiated in different languages but the entire geometry of prosodic structures is never simultaneously realized within a single language (Ito & Mester 2013).

  → Violates the expectation that prosodic hierarchy is a language universal.

  → Solution: proliferation can be avoided by allowing recursivity:

  What further emerge are subtypes of ω, ϕ, ι (Selkirk 2011).

ι	Intonation Phrase
φ	Phonological Phrase
ω	Prosodic Word

Recursion in higher-level prosodic structures

To avoid the proliferation of prosodic categories and encode isomorphism

E.g. This removes Clitics Group (CG), a constituent between ω and ϕ which has been claimed to be 'superfluous' (Vogel 2009):

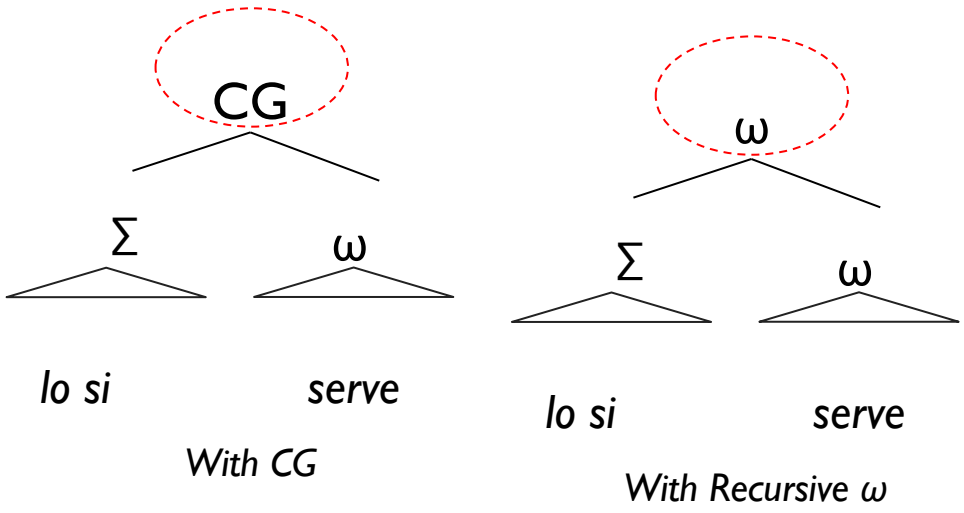
ω	Prosodic word
∑	Foot

Italian clitics *lo si*

[lo si [serve]]

it_{CL} one_{CL} serve

'one serves it.'



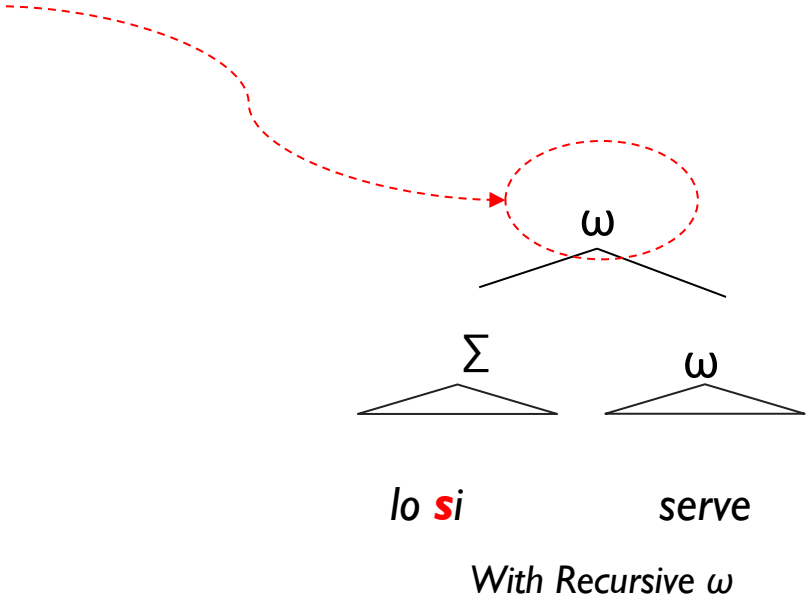
Recursion in higher-level prosodic structures

Italian clitics *lo si*

A side effect: recursive structures may exhibit distinct phonological properties

Intervocalic *s*-voicing: s → **z**/[...V___V…]$_{\omega}$

a. /caus-ano/ → [cau**z**-ano]$_{\omega}$ 'they cause'
b. /isola/ → [i**z**ola]$_{\omega}$ 'island'



With Recursive ω

Recursion in higher-level prosodic structures

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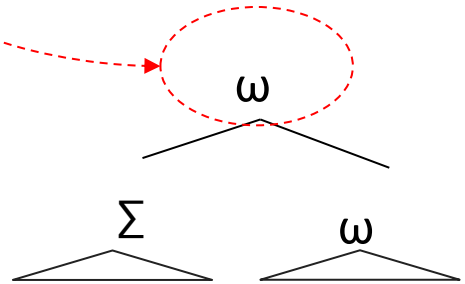
However, the *s*-voicing rule does not apply to clitics:

[lo **s**i [serve]$_{\omega}$]$_{\omega}$ *[lo **z**i [serve]$_{\omega}$]$_{\omega}$



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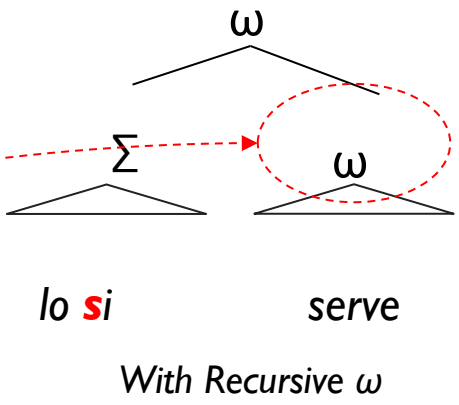
→ A solution is to modify the *s*-voicing as only applying within the inner ω.

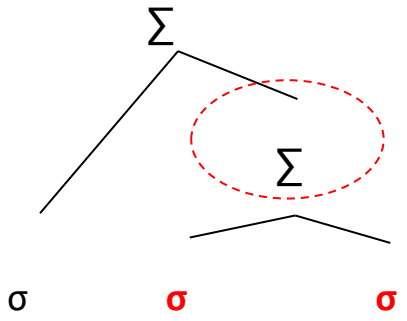


With Recursive ω

"Recursive" structures but non-recursive properties

In theories which advocate for recursivity, this has been argued as a desirable effect…

- Since inner and outer structures differ in configurational representations:



Recursive Foot

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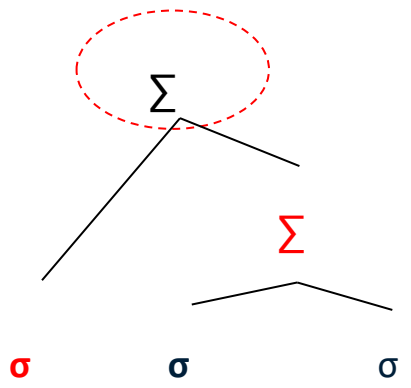


Recursive Foot

- Subtle differences between stressed/ unstressed syllables can be captured by:

a. the number of foot projections that dominate a syllable and/or
b. its particular position within the foot

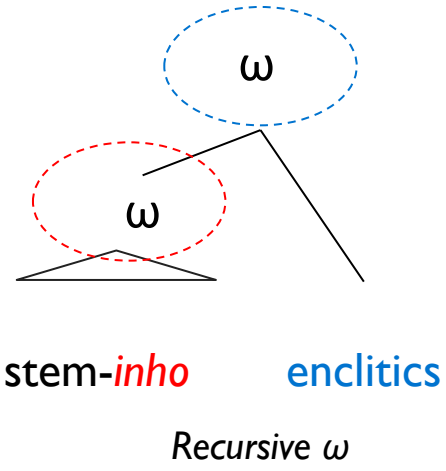
(Martínez-Paricio & Kager 2021: 44).

"Recursive" structures but non-recursive properties

In theories which advocate for recursivity, this has been argued as a desirable effect…

- Since inner and outer structures differ in configurational representations:

European Portuguese (Bermúdez-Otero & Luís 2009)



Recursive ω

- DIM suffix *-inho* and *-ito* & Pronominal enclitics are all attached at the word-level.
- Idiosyncratic behaviours between them are explained as prosodic effects:
  - DIM suffix adjoins under inner ω
  - Pronominal enclitics adjoins under outer ω

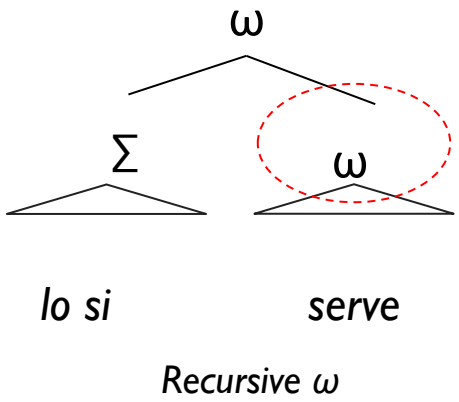
"Recursive" structures but non-recursive properties

In theories which advocate for recursivity, this has been argued as a desirable effect, since inner and outer structures differ in configurational representations.

- However, this makes "recursivity" a void concept: if the allegedly "recursive" structure may not share identical phonological properties and may correspond to distinct syntactic structures

  → they are not the same type.

- Can the same effect be derived by allowing ternary foot or re-placing additional prosodic categories (e.g. CG)?



Recursion is restricted in phonology

cf. syntax, phonology has "too little recursion"

- Some allegedly "recursive" structures may exhibit distinct phonological behaviors, and the same empirical facts are subject to alternative analyses without recursion.
- Note that there are some genuine recursive **effects** in higher-levels (e.g. Miller & Sande 2021),
  - i.e., with the same phonological properties.
  - But do these **effects** need to be stipulated in phonology?
  - This seems to depend on how we understand the mapping between syntax and phonology…

→ Adding together, recursion is generally suppressed in phonology.

Open questions

1. What prevents phonology from having recursion?
2. What should be counted as a valid definition of recursion which holds for both syntax and phonology
   - Is there a need to develop a unified definition? If not, what is the reason preventing us from doing that?

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