Modelling Exponents

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Introduction

- We have been working on L_RFG since 2016 and presenting it to this audience:
  - MOTH: (Asudeh and Siddiqi 2016)
  - Mo-MOT IV: (Melchin et al. 2019)
  - Mo-MOT V: (Asudeh and Siddiqi 2021)
- We have had a strong idea of v(ocabulary)-structure since the beginning, but we are now putting some meat on the bones.
- Goals of the talk:
  1. Develop a model of what is on the right of an exponent function
  2. Describe a factorial typology of phonological dependence in formal terms
  3. Exemplify with the English deadjectivizing verbalizer affix *-en*
- This is the general framework that we will motivate:

(1) $\langle \ldots, \ldots, \ldots \rangle \xrightarrow{v}$

PHON(OLOGICAL)	
REP(RESENTATION)	*phonological realization & conditions*
P(ROSODIC)FRAME	*prosodic unit*
P(ROSODIC)LEVEL	1 | 2
DEP(ENDENCE)	{LT, RT}
CLASS	{*inflectional classes*}
TYPE	VERBAL | NOMINAL | ADJECTIVAL
HOST	IDENT(ITY) AUNT | NIECE { *v-s* [PHON.REP ...; PFRAME ...; PLEVEL ...; DEP ...; CLASS ...; TYPE ...] }

- This is the Vocabulary Item (VI) for *-en* that we will motivate:[1]

(2) $\langle$ [v], Φ{ }, $\lambda P.\textsc{cause}(\textsc{become}(P))$ $\rangle$ $\xrightarrow{\nu}$

$$\begin{bmatrix} \textsc{phon.rep} & /\underset{\cdot}{\text{n}}/ \\ \textsc{pframe} & (\ldots(\cdot)_{\sigma})_{ft} \\ \textsc{plevel} & 1 \\ \textsc{dep} & \textsc{lt} \\ \textsc{class} & \textit{weak} \\ \textsc{type} & \textsc{verbal} \\ \textsc{host} & \begin{bmatrix} \textsc{ident} & \textsc{niece} \\ \left\{ \begin{bmatrix} \textsc{phon.rep} & /\ldots([\textbf{son}])[\textbf{obs}]/ \\ \textsc{pframe} & (\cdot)_{\sigma} \\ \textsc{type} & \textsc{adjectival} \end{bmatrix} \right\} \end{bmatrix} \end{bmatrix}$$

1 Phonological Features

1.1 Phonological Representation

- Conditions on mapping to output phonological form
  - Can be underspecified.
    - For example, much of English inflection is probably underspecified for [±voice].
  - Can be a memorized, conditioned list
    - For example, the English indefinite determiners (*a/an*) are listed, phonologically conditioned allomorphs.
    - This is the same approach we would take to French liaison.

1.2 Prosodic Frame

- Conditions on mapping to prosody
  - For example, SWEAR-insertion in English is sensitive to foot structure.
  - Similarly, *-um-* infixation (Austronesian) is sensitive to syllable structure.

1.3 Prosodic Level

- Specifies in which prosodic level the v-structure is integrated into prosody (primary vs secondary affixes)
  - For example, English geminates can only appear at level 2 morpheme boundaries.
  - Similarly, some Germanic prefixes are footed (level 1) and others are not (level 2).

[1] We adopt the convention of writing the value of a set-valued feature without set-brackets when it is a singleton set; e.g. [CLASS *weak*] instead of [CLASS {*weak*}].

1.4 Dependence

- The direction of the dependency
- Left, right, or both (infix)
  - {LT} := suffix ("I am dependent to the left")
  - {RT} := prefix ("I am dependent to the right")
  - {LT,RT} := infix ("I am dependent to the left and to the right")
- The presence of this feature entails phonological dependence.

2 Morphological features

2.1 Class

- Inflectional class
  - For example, this is where we would capture verb classes and noun classes, such as Latin declensions and conjugations.

2.2 Type

- Verbal vs Nominal vs Adjectival
- The morphological feature type is an attempt to capture coarse-grained, universal morphological categories, which are instantiated in syntax at a much finer grain.
- The fine grain instantiation is represented in the first coordinate of the *input* to $\xrightarrow{\nu}$.
  - For example, Infl, Tense, AgrS, AgrO, Voice, and Aspect are all distinct categories in the first/c-structure coordinate of the input to $\xrightarrow{\nu}$.
    - However, if they are specified with a TYPE feature on the output side, it is [TYPE VERBAL].[2]
- Another example: the deadjectivizing verbalizer we look at in section will be specified as [TYPE VERBAL], but will select for a host that is [TYPE ADJECTIVAL].
  - You may ask, "Why not put this in the tree/c-structure?"
    - The answer is that we do not want to complicate our trees with different varieties of the relevant functional heads (v, a, etc.), when we know this information needs to be in the v-structure.
- For example, agreement morphology (ϕ-features) has different exponents when present in distinct TYPEs (e.g., nominal concord vs. subject agreement).
- We deploy the TYPE feature to account for phenomena that are accounted for by 'head movement' in Minimalism, such as 'V-to-T movement' in French.
  - In particular, the TYPE feature constrains the distribution of forms with HOST features such that if prosodic inversion of a hosted form fails, a competing free form surfaces ('emergence of the unmarked').
  - For example, this is how we handle English *do*-support. The affixal form *-s* has [HOST {[TYPE VERBAL]}]. When this constraint is not met, the free form *does* appears.

[2] It may be the case that this has to be relaxed for so-called 'mixed category morphology'. However, we would first seek to model this with underspecification of the input category or of TYPE. We aim to explore this further in future work.

3 Morphosyntactic features

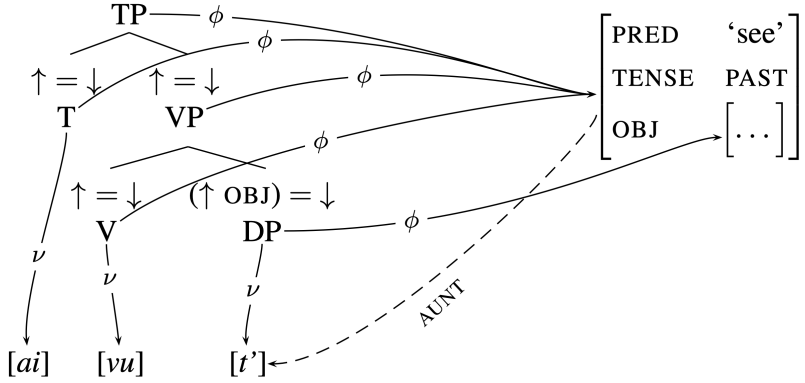
3.1 Host

- The value of the HOST attribute is a hybrid object that contains the IDENT(ITY) feature and a v-structure that has features PHON.REP, PFRAME, CLASS, and TYPE.
- Note that the HOST feature does not contain HOST.
  - This means that it is impossible for something to specify that its HOST has its own HOST, yielding a strong notion of locality.

3.1.1 Identity

- The identity of the correspondent of the HOST v-structure: AUNT or NIECE
- AUNT involves a reference to f-structure configuration, whereas NIECE refers to c-structure configuration.
- AUNT := The HOST is the prosodic domain corresponding to the set of v-structures that contain [HOST {[TYPE α]}] and map to the set of c-structure nodes that map to the f-structure that selects for my exponendum.

(3)

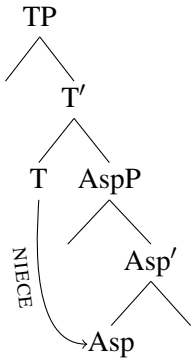


- For example, this is how we would capture object clisis in Romance languages.

  (4) Je t'ai vu.

- NIECE := The HOST is the prosodic domain that corresponds to the v-structure that realizes the head of the c-structure phrase that my exponendum takes as its c-structure complement.

(5)



- In this tree, NIECE(ASP) = $\rho(\nu(\lambda^{-1}(\text{Asp})))$.[3]
- For example, this is how we would capture typical inflectional affixation, such as in the verbal spine.

[3] λ is the labelling function, so λ^{-1}(Asp) returns the node labelled Asp. ν applied to the node returns a v-structure. ρ applied to the v-structure returns its p-structure correspondent.

Ta-da!

(6) $\langle \ldots, \ldots, \ldots \rangle \xrightarrow{\nu}$

$$\begin{bmatrix} \text{PHON(OLOGICAL)} & \\ \text{REP(RESENTATION)} & \textit{phonological realization \& conditions} \\ \text{P(ROSODIC)FRAME} & \textit{prosodic unit} \\ \text{P(ROSODIC)LEVEL} & 1 \mid 2 \\ \text{DEP(ENDENCE)} & \left\{ \text{LT, RT} \right\} \\ \text{CLASS} & \left\{ \textit{inflectional classes} \right\} \\ \text{TYPE} & \text{VERBAL} \mid \text{NOMINAL} \mid \text{ADJECTIVAL} \\ \text{HOST} & \begin{bmatrix} \text{IDENT(ITY)} & \text{AUNT} \mid \text{NIECE} \end{bmatrix} \\ & \left\{ \textit{v-s} \begin{bmatrix} \text{PHON.REP} & \ldots \\ \text{PFRAME} & \ldots \\ \text{PLEVEL} & \ldots \\ \text{DEP} & \ldots \\ \text{CLASS} & \ldots \\ \text{TYPE} & \ldots \end{bmatrix} \right\} \end{bmatrix}$$

4 MostSpecific

- L_RFG posits a constraint on the expression of phonological information, i.e. *morphophonology*, which we have called **MostSpecific**.
- **MostSpecific**(α, β) returns whichever Vocabulary Item has the most restrictions on its phonological context.
- Let V^o be the co-domain of the exponence function ν in some language L, i.e. the set of outputs of Vocabulary Items in L. We write $V^o(\alpha)$ to indicate the co-domain of some particular Vocabulary Item, α — i.e., the output vocabulary structure.
- The proper subsumption relation on feature structures — i.e., v-structures — is used to capture the intuition (below).

(7) Given two Vocabulary Items, α and β,

$$\textbf{MostSpecific}(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } (V^o(\beta) \text{ HOST}) \sqsubset (V^o(\alpha) \text{ HOST}) \\ \beta \textbf{ if } (V^o(\alpha) \text{ HOST}) \sqsubset (V^o(\beta) \text{ HOST}) \\ \bot \textbf{ otherwise} \end{cases}$$

- The intuition behind **MostSpecific** is to prefer affixes, whenever possible. In terms of information encoded in Vocabulary Items, choose the VI whose output v-structure has more specific content in the HOST feature.
- For example, if English comparative *-er* and *more* (which contains no HOST features) are in competition and *-er*'s HOST features are satisfied, **MostSpecific** will select *-er*.
- Similarly, if English verbal inflection *-s* and *does* (which contains no HOST features) are in competition and *-s*'s HOST features are satisfied, **MostSpecific** will select *-s*.

5 DEPENDENCY & HOST: Classifying forms

1. Free form

   (8) $\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \end{bmatrix}$

2. Clitic$_a$ (leaners/simple clitics)

   (9) $\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \\ \text{DEP} & \dots \end{bmatrix}$

   - For example, the English possessive *'s* and auxiliary *'ll* are specified [DEP LT], as they lean on the preceding element.
   - However, they are not fussy about what that element is.

   (10) English possessive *'s*
   a. The car's fender
   b. The car you are in's fender

   (11) English "contractions"
   a. The person who arrives first'll leave last
   b. The person who finds them'll leave last

3. Clitic$_b$ (special clitics)

   (12) $\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \\ \text{DEP} & \dots \\ \text{HOST} & \begin{bmatrix} \text{IDENT} & \text{AUNT} \end{bmatrix} \end{bmatrix}$

   - For example, French object clitics are specified for [DEP RT], which captures proclisis on AUNT.

   (13) $\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \\ \text{DEP} & \text{RT} \\ \text{HOST} & \begin{bmatrix} \text{IDENT} & \text{AUNT} \end{bmatrix} \end{bmatrix}$

   (14) French pronominal objects
   Je t'ai vu.
   1.SG 2.SG=PAST see
   'I saw you'

4. Clitic$_c$ (phonological clitics)

   - There is a third kind of clitic whose dependence properties are not determined by v-structure, but rather just by their phonology.
     - For example, in the Frans Planck example, *drink a pint of milk*, the prosodic constituency is (*drinka*) (*pinta*) (*milk*).
     - The phonological dependence of these examples is entirely a product of prosodic structure i) footing together *drink* and the reduced form of the indefinite determiner *a* and ii) footing together *pint* and the reduced form of the preposition *of*.
     - In other words, this kind of prosodic phrasing is captured in p-structure (Bögel 2015), and simply arises from the fact that the relevant functional words (in this case, *a* and *of*) have /ə/ allomorphs.
   - Therefore, the clitic$_c$ variety in fact does not have a DEP feature in v-structure at all, because its surface dependence is no more lexically conditioned than the surface dependence of *drink* or *pint*.
   - Thus, the v-structure template for clitic$_c$ is identical to the one for free forms in (8) above.

5. Affix

   - Affixes arise from the combination of some DEP value and [IDENT NIECE].

   (15) $\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \\ \text{DEP} & \dots \\ \text{HOST} & \begin{bmatrix} \text{IDENT} & \text{NIECE} \end{bmatrix} \end{bmatrix}$

   - Furthermore, we adopt a prosodic level account for the different phonotactic restrictions on affixation.
   - Restricted affixes, also called primary or level 1 affixes, have [PLEVEL 1].

   (16) *illogical* ("i-logical" not "ill-logical")
   No English morpheme-boundary geminate

   - Unrestricted affixes, also called secondary or level 2 affixes, have [PLEVEL 2].

   (17) *unnatural*
   English morpheme-boundary geminate

5.1 Factorial typology over DEP × HOST

- This yields a factorial typology of major morphological kinds, as shown in Table 1.
- Note that (● FEAT) and ¬(● FEAT) are standard LFG notation for indicating respectively the obligatory presence or absence of feature FEAT in the structure designated by ●.

	¬[● HOST]	[● HOST IDENT AUNT]	[● HOST IDENT NIECE]
[● DEP]	*clitic*$_a$ *(leaner/simple clitic)*	*clitic*$_b$ *(special clitic)*	*affix*
¬[● DEP]	*free form* *clitic*$_c$ *(phonological clitic)*		

Table 1: A factorial typology of major morphological kinds

6 An example: *-en*

- The English affix *-en*, as in *blacken*, is perfectly productive assuming certain phonological well-formedness conditions:

1. This affix is consistently pronounced as a syllabic /n/.
   ∴ [PHON.REP /n̩/]
2. The affix is a syllable that is the last in its foot.
   ∴ [PFRAME $(\ldots(\cdot)_{\sigma})_{ft}$]
3. The affix form is subject to local word-level phonotactics.
   ∴ [PLEVEL 1]
4. The affix is dependent to its left; i.e. it is a suffix.
   ∴ [DEP LT]
5. The resulting verb is a weak verb (in the Germanic sense); e.g. it takes *-ed* in the past participle, unlike strong verbs like *write*, which take *-en*. For the purpose of illustration, we identify two classes in English, *weak* and *strong*.[4]
   ∴ [CLASS *weak*]
6. For the purposes of this illustration, let's assume that *do*-support happens because the affix *-s* requires its HOST to be [TYPE VERBAL] (see section 2.2 above). In other words, the resulting verb does not itself trigger *do*-support.
   ∴ [TYPE VERBAL]
7. The affix 'lowers' to the head of the complement of the affix.
   ∴ [HOST IDENT NIECE]
8. The affixed form must meet phonological and prosodic conditions on the host.
   - The output form of the base must be no longer than one syllable and end in an obstruent, optionally preceded by a sonorant (per Halle 1973).[5]
     - For example, *soften* is legal despite a seemingly illegal base, because the final /t/ in the base is not present in the output [sɑfn̩].
     - We know this is a phonological constraint on the host and not a general phonological rule in English, because unaffixed forms with similar phonology are legal (e.g., **dryen* but *lion*, **dimmen* but *women*).

   ∴ [HOST {[PHON.REP /…([**son**])[**obs**]/]}]
   ∴ [HOST {[PFRAME $(\ldots)_{\sigma}$]}]
9. The affix can only attach to adjectives.
   ∴ [HOST {[TYPE ADJECTIVAL]}]

(18) $\langle$ [v], Φ{ }, $\lambda P.\text{CAUSE}(\text{BECOME}(P))$ $\rangle$ $\xrightarrow{\nu}$

$$\begin{bmatrix} \text{PHON.REP} & /\text{n̩}/ \\ \text{PFRAME} & (\ldots(\cdot)_{\sigma})_{ft} \\ \text{PLEVEL} & 1 \\ \text{DEP} & \text{LT} \\ \text{CLASS} & \textit{weak} \\ \text{TYPE} & \text{VERBAL} \\ \text{HOST} & \begin{bmatrix} \text{IDENT} & \text{NIECE} \\ \left\{ \begin{bmatrix} \text{PHON.REP} & /\ldots([\textbf{son}])[\textbf{obs}]/ \\ \text{PFRAME} & (\cdot)_{\sigma} \\ \text{TYPE} & \text{ADJECTIVAL} \end{bmatrix} \right\} \end{bmatrix} \end{bmatrix}$$

[4] This is meant to be illustrative of the feature CLASS. Contemporary English probably does not have active CLASS features; rather, forms with *-en* are simply irregular.

[5] We are presenting an unadulterated version of Halle's (1973) theory, but we are aware of complications, such as the well-formedness of *crispen*, which we set aside here.

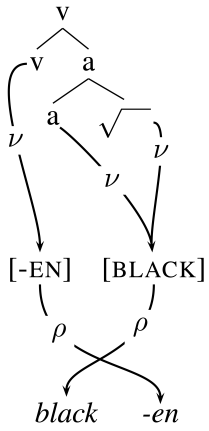
- Using • to represent "this v-structure" and · to represent "the p-structure correspondent of this v-structure" (i.e., $\rho(\bullet)$), the equivalent description is shown in (19). Note that the set membership symbol, $\in$, is used here in a standard LFG way to indicate a path that goes into a set.

(19) (• PHON.REP) = /n̩/
(• PFRAME) = $(\ldots(\cdot)_{\sigma})_{ft}$
(• PLEVEL) = 1
(• DEPENDENCE) = LT
(• CLASS) = *weak*
(• TYPE) = VERBAL
(• HOST IDENT) = NIECE
(• HOST $\in$ PHON.REP) = /…([**son**])[**obs**]/
(• HOST $\in$ PFRAME) = $(\ldots)_{\sigma}$
(• HOST $\in$ TYPE) = ADJECTIVAL

- Note that the re-ordering of the affix and host happens at p(rosodic)-structure, via the ρ correspondence function.

- The L_RFG c-structure with additional mapping indicated is:

(20)



- The less marked alternative is a zero-marked form, which in L_RFG is a result of the fact that *Pac-man Spanning* (Melchin et al. 2020b) is always competing with overt exponence, since L_RFG does not employ zero affixation.

- Pac-man Spanning is the result of the three **MostInformative** constraints preferring portmanteaus, whenever the DEP requirements of *-en* are not satisfied.

(21)

Pac-man Spanning	*-en* Affixation
to orange	to redden
to yellow	to blacken
* to red	* to orangen
* to black	* to yellowen

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[6]Most of these are L_RFG work and are available at lrfg.online.