The Ins and Outs of Exponence

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Introduction

- This talk introduces Lexical-Realizational Functional Grammar (L_RFG), a framework for lexical-realizational morphology (Stump 2001) within the context of a general architecture for grammatical analysis.
- The L_RFG project is led by me and Dan Siddiqi (Carleton University). We are developing the framework in collaboration with several international collaborators and our graduate students at Carleton and Rochester.
  - Our current collaborators are Oleg Belyaev (Moscow State University), Bronwyn Bjorkman (Queen's University), Tina Bögel (Frankfurt and Konstanz Universities), Michael Everdell (UT, Austin), Paul Melchin (ex-Carleton), and Will Oxford (University of Manitoba).
  - The students currently working on the project are Veronica Burrage (PhD, Rochester) and Sam Turnbull (PhD, Carleton).
- Prior L_RFG work includes Melchin et al. (2020a,b), Everdell and Melchin (2021), Everdell et al. (2021), Siddiqi (2021), Asudeh et al. (2021), and Asudeh and Siddiqi (2022a,b).
  - Please see the project website for these papers, as well as material from presentations (handouts and slides): lrfg.online

Overview of the talk

Section 1 motivates and introduces the framework.

Section 2 introduces the exponence function, $\xrightarrow{\nu}$, which is at the heart of the framework.

Section 3 focuses on *morphosyntax*, in terms of the the *syntactic inputs* to $\xrightarrow{\nu}$. to ν

Section 4 focuses on *morphosemantics*, in terms of *semantic inputs* to $\xrightarrow{\nu}$.

Section 5 focuses on *morphophonology* and *realization*, in terms of the *output* of $\xrightarrow{\nu}$.

*This talk is based on three pieces of joint work (Melchin et al. 2020b, Asudeh and Siddiqi 2022b, Asudeh et al. 2022). Any errors or misrepresentations are my sole responsibility.

1 Lexical-Realizational Functional Grammar

1.1 Motivation

- L_RFG is the offspring of a perhaps unlikely marriage between Distributed Morphology (DM; Halle and Marantz 1993) as a theory of morphological realization and Lexical-Functional Grammar (LFG; Kaplan and Bresnan 1982) as an architecture and framework for grammatical analysis (including but not limited to syntax).
- L_RFG combines the strengths of the two frameworks:
  1. Like LFG, it is a declarative, representational and constraint-based theory (without the bottom-up, phase-based derivations of Minimalism) that is ideally suited to modelling *nonconfigurationality*.
  2. Like DM, it provides a realizational, morpheme-based view of morphology and is good at modelling complex morphological structures including *polysynthesis*, as found in many North American Indigenous languages.
- Additionally, because the realizational module, v(ocabulary)-structure, feeds prosody and phonology, L_RFG has the potential to give non-transderivational (and thus hopefully computationally simpler) prosodic explanations for morpheme alignment and surface form phenomena that are typically alternatively analyzed in transderivational harmonic approaches to the morphology-phonology interfaces such as Optimality Theory (Prince and Smolensky 1993, 2004).

1.2 Architecture and example

- L_RFG is syntactically similar to standard LFG, with changes to the c(onstituent)-structure tree and its relationship with morphosyntactic elements.
- L_RFG's version of the LFG Correspondence Architecture (Kaplan 1989, 1995, Asudeh 2006, 2012a) is shown in Figure 1.
- The output of the grammar for any particular set of input formatives, is a form–meaning pair where the form incorporates prosody (fed by constituent structure, as in LFG) and the meaning incorporates information structure (fed by semantic structure, as in LFG).[1]

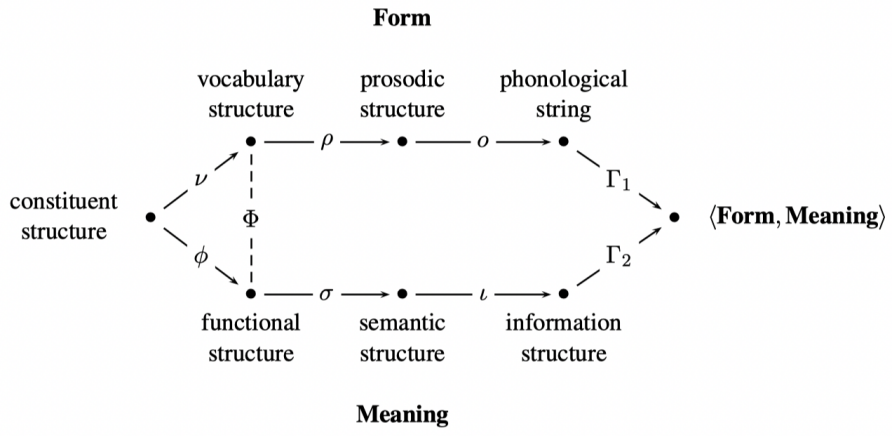
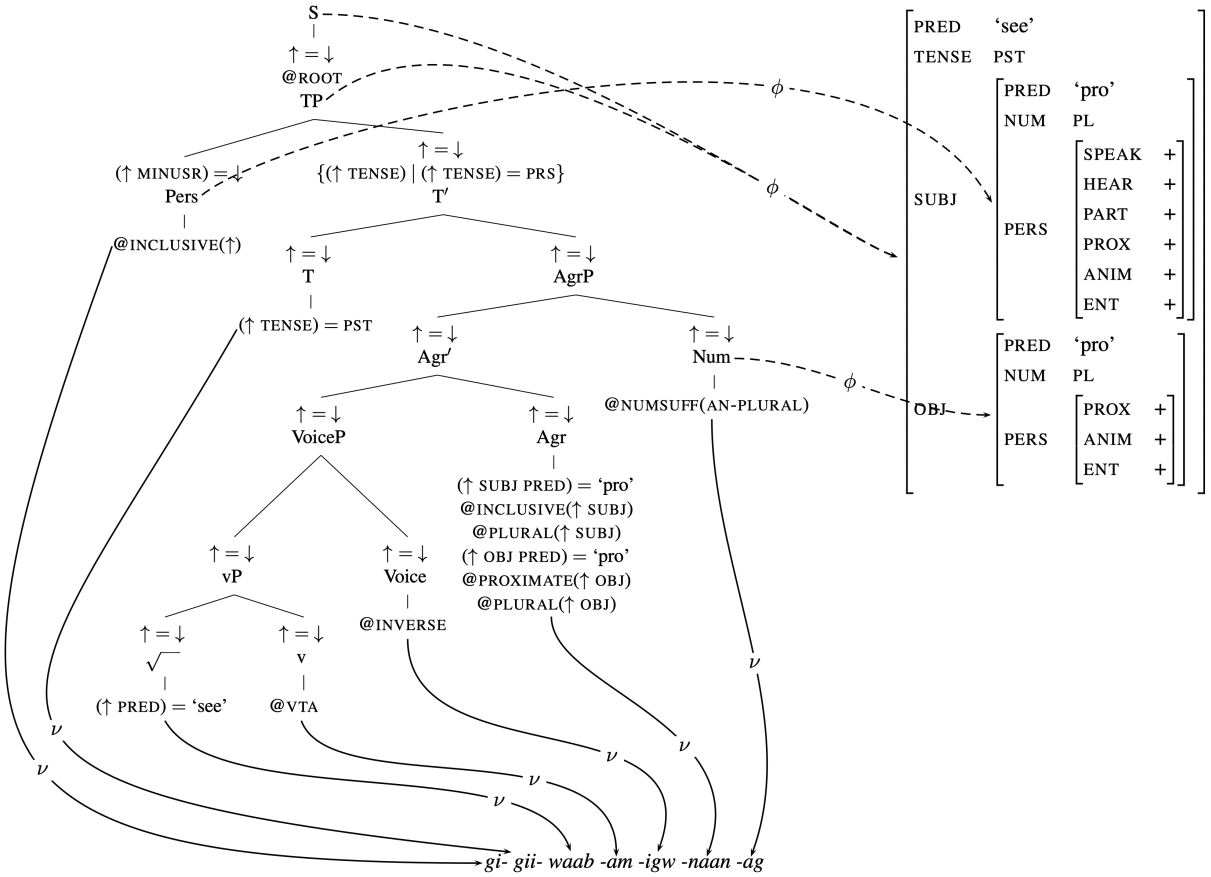


Figure 1: L_RFG's correspondence architecture

[1]Note that the *set* of all grammatical form-meaning pairs may have a given form recurring in several pairs, if it is ambiguous, or a given meaning recurring in several pairs, if it is expressible in alternative ways.

- The terminal nodes of c-structures *are not words*, but instead are *f-descriptions* (sets of f(unctional)-structure equations and constraints) and Glue Semantics *meaning constructors* (terms that are used in the computation of compositional semantics).
- The c-structure is mapped to a *v(ocabulary)-structure*, based on *Vocabulary Items* (VIs) that realize (a.k.a. *expone*) c-structural, f-structural, and semantic information, via a correspondence function, ν.
- A v-structure is thus an interface representation that:
  1. Is the output of the function ν that realizes syntactic and semantic information; and
  2. Is the input to the function ρ which maps to p(rosodic)-structure.
- Here is an example from Ojibwe (*Anishinaabemowin*, Algonquian) to demonstrate the basics of L_RFG.[2]

(1) gi- gii- waab -am -igw -naan -ag — Ojibwe (Anishinaabemowin)
2 PST see VTA INV 1PL 3PL
'They saw us, including you.'



- The relationship between terminal nodes and the c-structural input to VIs is many-to-one, using the mechanism of *Spanning* (Haugen and Siddiqi 2016, Merchant 2015, Ramchand 2008, Svenonius 2016); i.e. one VI may realize features of multiple terminal nodes.
- The result has some similarities to the Lexical Sharing model proposed for LFG by Wescoat (2002, 2005, 2007), but maintains, like DM, that the complex internal structures of words are part of syntax.

[2] I leaves semantics aside for now.

1.3 Comparison with L_RFG's parent frameworks, LFG and DM: Highlights

- The obvious point of contrast between L_RFG and LFG concerns the Lexicalist Hypothesis (Chomsky 1970, Lapointe 1980):

  (2) *Lexicalist Hypothesis*
  No syntactic rule can refer to elements of morphological structure. (Lapointe 1980: 8)

- In LFG this is captured in the *Lexical Integrity Principle*, through formulations like the following:

  (3) *Lexical Integrity*
  Morphologically complete words are leaves of the c-structure tree, and each leaf corresponds to one and only one c-structure node. (Bresnan et al. 2016: 92)

- This statement has two parts:

  1. L_RFG *upholds* the part that states that "each leaf corresponds to one and only one c-structure node".
  2. L_RFG *rejects* the part that states that "morphologically complete words are leaves of the c-structure tree".
     - Clearly, the c-structure leaves/terminals in L_RFG are not "morphologically complete words". The c-structure leaves/terminals are feature bundles that *map* to form, but the form itself is not part of the terminal node.

- However, notice that the notion *morphologically complete word* is left unanalyzed in the definition in (3).

- In fact, it is far from clear that "morphologically complete word" is a coherent notion (see, for example, Anderson 1982).

- The essential problem is that there are multiple relevant notions of wordhood, and they don't align on a single type of object that we can point to and unambiguously and confidently call a word (Di Sciullo and Williams 1987).[3]

- There can be mismatches between the phonological, syntactic, and semantic aspects of words (Marantz 1997).

  1. Portmanteau words are examples of things that are phonologically simple but semantically and syntactically complex.

     (4) Tu bois **du** lait. French
     you drink of.DEF.MASC.SG lait
     'You drink/are drinking milk.'

     (5) **Imma** go. English dialect
     1SG.FUT.PROX go
     'I'm about to go.'

  2. Idiomatic expressions are phonologically and syntactically complex, but not necessarily semantically complex, and never in a way that maps entirely transparently to their phonology and syntax.

     (6) I read **the shit out of** this book.
     INTENSIFIER
     'I thoroughly read this book.'

  3. Units of syntax can be phonologically or semantically dependent on their contexts.

     (7) Je **l**'ai vu. French clitic
     I 3SG saw
     'I saw it.'

     (8) The cat's been **let out of the bag**.

[3] This is a long and broad discussion that I can't possibly do justice to here.

- L_RFG thus countenances three criteria for wordhood, following DM:
  1. A word as an unanalyzed phonological string (phonological criterion)
  2. A word as a lexicalized string with a non-compositional meaning (semantic criterion)
  3. A word as a syntactic atom (syntactic criterion)
- Like DM, L_RFG is a realizational, morphemic model of morphology that focuses on morphological interfaces.
- These interfaces are captured by the arrangement of discrete structures and correspondence functions between them, an idea inherited from LFG.
- However, unlike mainstream DM, which assumes a Minimalist syntax (for mostly socio-historical reasons, it seems), L_RFG is a *non-derivational*, *constraint-based* model of grammar.
- Lastly, constraints in L_RFG are an inherent part of the formal framework and do not constitute an OT-like augmentation to the underlying realizational model.

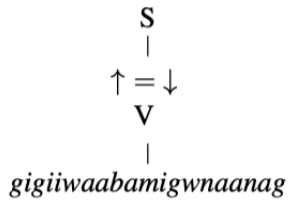
1.4 Comparison with standard LFG

- L_RFG is similar to standard LFG, with changes to the c-structure and its relationship with morphosyntactic elements.
- The terminal nodes of c-structures do not contain any information about form, only syntactic and semantic information.
  - The syntactic information in terminal nodes is captured in f-descriptions, which define and constrain LFG's f(unctional)-structures.
  - The semantic information in terminal nodes is expressed in terms of *meaning constructors* from Glue Semantics (Dalrymple et al. 1993, Dalrymple 1999). The information is not merely ad hoc 'feature semantics' or 'markerese'.
- The syntactic and semantic information in represented in c-structure is realized in a v(ocabulary)-structure, which is represented as a feature structure (attribute-value matrix).
- V-structure includes the phonological form of the exponent, but also information for interfacing with p(rosodic)-structure.
  - Thus, the v-structure roughly corresponds to the p(honological)-form portion of a lexical entry in the constraint-based metrical theory of Bögel (2015).
- In other words, L_RFG assumes that there are three notions of wordhood that sometimes happen to align, but can diverge, i.e., there are mismatches between the three types of wordhood.
- With its focus on mismatches, L_RFG is therefore strongly in the spirit of LFG.
- L_RFG uses the standard *co-description* mechanism of LFG (for recent exposition, see Dalrymple et al. 2019) to simultaneously state the phonological, syntactic and semantic aspects of formatives.
- Here are some possible points of comfort for an LFGer gazing on L_RFG's familiar yet alien landscape:
  1. L_RFG could be considered to be offering a morphological theory for LFG that had previously been captured by somewhat ad hoc devices like phrase structure rules for word formation; see, e.g., the discussions of Japanese and West Greenlandic in Bresnan et al. (2016). In other words, LFG owes some kind of theory

of word structure, which has generally been lacking until recently (see, e.g., Dalrymple 2015, Dalrymple et al. 2019, Thomas 2021), and L_RFG seeks to pay that debt.[4]

2. The Vocabulary Items of L_RFG contain much the same information as LFG's lexical entries, but without the commitment that morphophonological form is bundled as part of the lexical entry. It should be possible to specify an algorithm for translating L_RFG's VIs into LFG lexical entries.
3. Related to the first two points, if one were to want to maintain some version of the Lexicalist Hypothesis, one could view L_RFG as offering a microscopic view of the structure of "words", in particular major categories like verb and noun. For example, the TP node in (1) in some sense *is* the verb, but the L_RFG c-structure shows its internal structure.

   A standard LFG c-structure for example (1) would instead look like the following (setting the f-description aside).

(9)


2 The exponence function, ν

- The exponence function ν maps from a triple to a v(ocabulary)-structure, the exponent.
  1. The first argument is a list of pre-terminal categories, typically of length 1, which are taken in the linear order they appear in the tree.
  2. The second argument is itself a function, Φ, which maps an f-description to the set of f-structures that satisfy the description; i.e. $\Phi(d \in D) = \{f \in F \mid f \models d\}$, where D is the set of valid f-descriptions and F is the set of f-structures.
  3. The third argument is a set of *meaning constructors* from Glue Semantics (Glue; among others, Dalrymple 1999, Dalrymple et al. 2019, Asudeh 2012b).[5]

- Meaning constructors are pairs of terms from two logics (the colon is an uninterpreted pairing symbol):

  (10) $\mathcal{M} : G$

- $\mathcal{M}$ is an expression of the *meaning language* — anything that supports the lambda calculus. G is an expression of *linear logic* (Girard 1987), which specifies semantic composition based on a syntactic parse that instantiates the general terms in G to a specific syntactic structure.

- The meaning constructors serve as premises in a linear logic proof of the *compositional semantics*.

  (11) Alex likes Blake.

  (12) Meaning constructors: $\mathbf{alex} : a$
  $\mathbf{blake} : b$
  $\lambda y.\lambda x.\mathbf{like}(y)(x) : b \multimap a \multimap l$

- Note that $\lambda y.\lambda x.\mathbf{like}(y)(x)$ is η-equivalent to just **like**, but it is useful to use the expanded form to make the structure of the following proof more obvious.

[4] For a discussion of morphology in LFG, see Asudeh and Siddiqi (2022a).
[5] For a recent high-level introduction to Glue Semantics, see Asudeh (2022) or Asudeh (forthcoming).

(13)
$$\dfrac{\textbf{alex} : a \qquad \dfrac{\lambda y.\lambda x.\textbf{like}(y)(x) : b \multimap a \multimap l \qquad \textbf{blake} : b}{\lambda x.\textbf{like}(\textbf{blake})(x) : a \multimap l}\ \multimap_{\mathcal{E}}, \Rightarrow_{\beta}}{\textbf{like}(\textbf{blake})(\textbf{alex}) : l}\ \multimap_{\mathcal{E}}, \Rightarrow_{\beta}$$

- The colours in the proof are not part of the representation, but highlight the meaning constructors as opposed to compositionally derived meanings, which are in black.
- Here are two sample VIs, the first for the Ojibwe root *waab* ('see') and the second for the English equivalent *see*.[6] Note that we use the η-equivalent form of the **see** function to reduce clutter.

(14) Ojibwe
$\langle\ [\sqrt{\ }], \Phi\{(\uparrow \text{PRED}) = \text{'see'}\}, \{\textbf{see} : (\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma\}\ \rangle \quad \xrightarrow{\nu} \quad \textit{waab}$

(15) English
$\langle\ [\sqrt{\ }], \Phi\{(\uparrow \text{PRED}) = \text{'see'}\}, \{\textbf{see} : (\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma\}\ \rangle \quad \xrightarrow{\nu} \quad \textit{see}$

- In a c-structure tree, this is represented as follows:

(16)
$$\begin{array}{c} \sqrt{\ } \\ | \\ (\uparrow \text{PRED}) = \text{'see'} \\ \textbf{see} : (\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma \end{array}$$

Henceforth, I will show only the meaning language side of the Glue meaning constructors.

2.1 Conditions on exponence

- Let V^i be the domain of the exponence function ν in some language L, i.e. the set of inputs to Vocabulary Items in L.
- We write $V^i(\alpha)$ to indicate the domain of some particular Vocabulary Item, α.
- We write $\pi_n(V^i(\alpha))$ to indicate the n^{th} projection of $V^i(\alpha)$. For example, $\pi_1(V^i(\alpha))$ returns the c-structure list in the first projection of the input to Vocabulary Item α.[7]
- The following conditions on exponence hold.[8]

1. **MostInformative**$_c(\alpha, \beta)$ returns whichever of α,β has the longest list of c-structure categories.

   The proper subset relation on lists-as-sets is used to capture the intuition (below). We can think of a list as a set of pairs, where the first member of each pair is an integer indexing the second member's position in the list.

   (17) Given two Vocabulary Items, α and β,
   $$\textbf{MostInformative}_c(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } f = \pi_1(V^i(\alpha)) \wedge g = \pi_1(V^i(\beta)) \wedge g \subset f \\ \beta \textbf{ if } f = \pi_1(V^i(\alpha)) \wedge g = \pi_1(V^i(\beta)) \wedge f \subset g \\ \bot \textbf{ otherwise} \end{cases}$$

- The **intuition** behind **MostInformative**$_c$ is: whenever possible, prefer portmanteau forms.

[6] The colours in (14) are not part of the representation. They are just there to help you parse out the parts better.

[7] This π is just standard notation for retrieving arguments to functions and should not be mistaken for a correspondence function.

[8] **MostInformative**$_f$, which is based on the subsumption relation between f-structure, is clearly related to the proposal of Andrews (1990). However, **MostInformative**$_c$ and **MostInformative**$_s$ have no correlates in that system, so the overall proposal is distinct.

- We use the term *portmanteau* as any Vocabulary Item that has size greater than one for any of its three input coordinates in V^i, i.e. its list of categories, set of f-descriptions, or set of Glue meaning constructors.
- In terms of lists of categories in Vocabulary Items, choose the VI that realizes the greater set of categories.

2. **MostInformative**$_f(\alpha, \beta)$ returns whichever of α,β has the most specific f-structure in the set of f-structures returned by Φ applied to α/β's collected f-description.

   The proper subsumption relation on f-structures (Bresnan et al. 2016: chap. 5) is used to capture the intuition (below).

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

$$\textbf{MostInformative}_f(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } \exists f \forall g. f \in \pi_2(V^i(\alpha)) \wedge g \in \pi_2(V^i(\beta)) \wedge g \sqsubset f \\ \beta \textbf{ if } \exists f \forall g. f \in \pi_2(V^i(\beta)) \wedge g \in \pi_2(V^i(\alpha)) \wedge g \sqsubset f \\ \bot \textbf{ otherwise} \end{cases}$$

- The **intuition** behind **MostInformative**$_f$ is, again to prefer portmanteau forms, whenever possible.
  - In terms of f-descriptions in Vocabulary Items, choose the VI that defines an f-structure that contains the greater set of features.

3. **MostInformative**$_s(\alpha, \beta)$ returns whichever Vocabulary Item has the more specific meaning.

   The proper subset relation on set-denoting expressions is used to capture the intuition (below).

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

$$\textbf{MostInformative}_s(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } f = \pi_3(V^i(\alpha)) \wedge g = \pi_3(V^i(\beta)) \wedge [\![f]\!] \subset [\![g]\!] \\ \beta \textbf{ if } f = \pi_3(V^i(\alpha)) \wedge g = \pi_3(V^i(\beta)) \wedge [\![g]\!] \subset [\![f]\!] \\ \bot \textbf{ otherwise} \end{cases}$$

- The **intuition** behind **MostInformative**$_s$ is to again prefer portmanteau forms, whenever possible.
  - In terms of meanings encoded in Vocabulary Items, choose the VI whose denotation is more semantically contentful.

- Two observations.
  1. **MostInformative**$_c$ and **MostInformative**$_f$ are *morphosyntactic* constraints, whereas **MostInformative**$_s$ is a *morphosemantic* constraint.
  2. Each version of **MostInformative** can result in a tie, represented by $\bot$.

3 Syntactic inputs to exponence: Morphosyntax

- In this section, I will focus on the first two arguments to the exponence function, ν.
- Recall that the first argument is a list of c-structure categories and the second is a function, Φ, that returns the set of f-structures described by the f-description that is the argument to Φ.
- I return to the third argument, the set of Glue meaning constructors in the next section.
- I demonstrate the L_RFG approach to morphosyntax with a grammar fragment for Ojibwe (Anishinaabemowin; glot:ojib1241), a polysynthetic/head-marking, non-configurational Algonquian language/group of dialects.

3.1 Language background

- Ojibwe grammar has many features that are mostly shared with the other Algonquian languages:
  - Typical **polysynthetic** morphysyntactic features, including nonconfigurationality, extensive head-marking, and various kinds of incorporation
  - Agreement morphology determined by a **prominence hierarchy**, which involves:
    - A system of grammatical gender based on **animacy**
    - A system of **obviation** distinguishing clause-mate third-person animate arguments
  - A **direct-inverse** system that indicates the relationship between thematic roles and the person hierarchy
  - Two separate inflectional paradigms: **independent order**, found in most matrix clauses, and **conjunct order**, found in subordinate clauses and certain matrix clause contexts
  - Separate (derivational) verb classes based on (i) transitivity and (ii) the animacy of the object (if transitive) or subject (if intransitive)

3.1.1 Animacy

- Ojibwe grammatical gender is based on animacy (**animate** vs. **inanimate**).
- All nouns referring to notionally/semantically animate entities are grammatically animate; however, notionally inanimate nouns may be of either gender.
- Animacy (of the subject or object) determines the verb final suffix (i.e., verb class, *v*) that is used, among other things.

3.1.2 Obviation

- Obviation distinguishes third-person animate clausemates: in any clause, one third-person animate argument is **proximate**, and the rest are **obviative**.
- The choice of which argument is proximate is mainly based on (poorly-understood) pragmatic/discourse factors.
- Obviation is marked on nouns and is distinguished in verb agreement.
- Obviative nouns are unspecified for number (except in isolated inflectional contexts), and can be interpreted as singular or plural.

3.1.3 The prominence/person hierarchy

- The distribution of agreement affixes, and the choice of direct or inverse morphology, is based on arguments' relative positions in a **prominence/person hierarchy**.
- This ranks arguments in terms of person, obviation and animacy.
- The hierarchy is as follows (Valentine 2001: 268; abbreviations largely follow common Algonquianist practice):[9]

[9] It should be noted that, while the ranking of 2 above 1 determines the insertion of the person prefix (at least on the view of Rhodes 1994, Rhodes and Valentine 2015, adopted here), there are other areas of the grammar where 1 appears to be ranked above 2, for instance when determining the insertion of certain agreement morphemes, and others where they appear to be equally ranked.

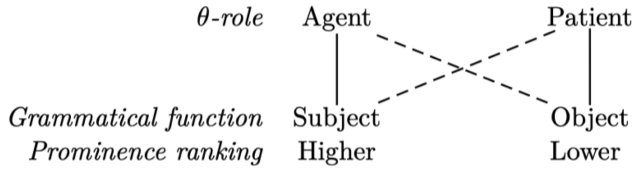
(20) *Prominence Hierarchy*

2	2nd person
1	1st person
3	3rd person animate proximate
3′	3rd person animate obviative
0	3rd person inanimate

3.1.4 Direct/inverse marking

- In transitive clauses, the relationship between the two arguments' relative ranking in the prominence hierarchy and their thematic roles is tracked by the **direct/inverse** morpheme, known as a Theme Sign (typically analyzed as Voice in recent theoretical treatments; e.g., Oxford 2014, 2019):
  - When the agent/actor is the higher-ranked argument and the patient is lower, the verb is marked as **direct**.
  - When the patient/undergoer is the higher-ranked argument and the agent is lower, the verb is marked as **inverse**.
- The theoretical status of inversion in Ojibwe is still under debate. One question involves the relationship between inversion and the grammatical functions of subject and object.
- We follow Rhodes (1994, 2010) and Bruening (2005) in assuming that the higher-ranked argument is always the subject and the lower-ranked argument is always the object.
- In the following diagram, the solid lines represent the correspondences form a direct form, and the dashed lines the correspondences for an inverse form.

(21) GFs-as-prominence (Melchin et al. 2020b: 276, following Rhodes 1994, 2010)
Direct: subject is agent, object is patient
Inverse: subject is patient, object is agent



3.2 Analysis

- The analysis presented in this section presents a fragment for a subset of the Ojibwe inflectional system, namely the pattern that occurs in (most) matrix clauses and involves animate subjects and (primary) objects.
- The clausal context (matrix versus embedded) is relevant because Ojibwe, like most other Algonquian languages, has two separate verbal inflectional paradigms or verbal "orders": independent order, which occurs in most matrix clauses; and conjunct order, which occurs in embedded clauses and certain matrix clauses, including *wh*-questions and certain narrative contexts.
- The two differ in much of their inflectional morphology, and in the distribution of direct and inverse marking.
- The Vocabulary Items given include most of the VIs that realize c-structure terminal nodes occurring between (but excluding) TP and vP.
- The focus will be on the independent order.

- The c-structure rules are not presented, but can be inferred from the c-structure.
- Above TP, Ojibwe is highly nonconfigurational, so we assume the root category is S, following common LFG practice for nonconfigurational languages (see, e.g., Bresnan et al. 2016):

(22) $\text{S} \rightarrow \underset{@\text{ANYGF}}{\text{XP}^*} \quad \underset{\substack{\uparrow = \downarrow \\ @\text{ROOT}}}{\text{TP}} \quad \underset{@\text{ANYGF}}{\text{XP}^*}$

3.2.1 Templates

- We make use of the LFG mechanism of **templates** (Dalrymple et al. 2004, Asudeh et al. 2008, 2013a) to encode bundles of grammatical descriptions that get expressed in the language.
- A template is nothing more than a *named description*.
- A template is invoked by the @ operator, whose semantics is simple substitution.
- We have just seen an instance of a template invocation in (22). The template is defined as follows:[10]

(23) $\text{ANYGF} := \{ (\uparrow \text{GF} - \text{ADJ}) = \downarrow \mid \downarrow \in (\uparrow \text{ADJ}) \}$

- Templates can perform a role in LFG similar to *types* in HPSG (Pollard and Sag 1994), but template hierarchies model *inclusion*, not *inheritance* (Asudeh et al. 2013b).
- The templates involved in this analysis can be divided into five groups:

1. General constraints
2. Prominence hierarchy (person/gender)
3. Obviation (number)
4. Verb classes
5. Argument structure to grammatical function mappings

General constraints

(24) *Transitive Subject Constraint*
$\text{TSC} := [(\uparrow \text{SUBJ}) \,\&\, (\uparrow \text{PLUSO})] \Rightarrow [(\uparrow \text{SUBJ ANIM}) = +]$

Purposes:

1. Ensures that transitives with an inanimate ARG_1 are inverse, regardless of context (independent or conjunct form).
2. Ensures that verbs with a secondary object (OBJ_θ) must have an animate subject.

(25) *Participant Argument Constraint*
$\text{PAC} := \neg(\uparrow \text{PLUSR PERS PART})$

Purposes:

1. Ensures that participant (i.e., 1/2PERS) pronominals are possible only as subjects and objects.
2. Ensures that secondary objects and obliques are 3rd person.

[10] The second template in (22), ROOT, is defined further below.

(26) ROOT := @TSC
@PAC

Purpose:

1. Ensures that the Transitive Subject Constraint and the Participant Argument Constraint hold of every sentence.

(27) *Prominence Constraints*

Purpose:

1. Capture the different distributions of direct and inverse voice heads in the independent and conjunct orders.

Independent Prominence Constraint
IPC := [(↑ SUBJ) & (↑ OBJ)] ⇒
{[(↑ SUBJ PERS PART) = + & (↑ OBJ PERS PART) = +] |
[(↑ OBJ PERS) ⊏ (↑ SUBJ PERS)]}

Conjunct Prominence Constraint
CPC := [(↑ SUBJ) & (↑ OBJ)] ⇒
{[(↑ {SUBJ|OBJ} PERS PART) = +] | [(↑ OBJ PERS) ⊏ (↑ SUBJ PERS)]}

Prominence hierarchy

Template	*Description*	*Explanation*
INCLUSIVE(f)	(f PERS SPEAK) = + (f PERS HEAR) = + @PARTICIPANT(f)	1st person inclusive
SPEAKER(f)	(f PERS SPEAK) = + @PARTICIPANT(f)	1st person
HEARER(f)	(f PERS HEAR) = + @PARTICIPANT(f)	2nd person
PARTICIPANT(f)	(f PERS PART) = + @PROXIMATE(f)	1 and/or 2
PROXIMATE(f)	(f PERS PROX) = + @ANIMATE(f)	3 and above
ANIMATE(f)	(f PERS ANIM) = + @ENTITY(f)	3′ and above
ENTITY(f)	(f PERS ENTITY) = +	All persons (0 and above)

Obviation

Template	*Description*	*Explanation*
PLURAL(f)	(f NUM) = PL	
SINGULAR(f)	(f NUM) = SG	
INAN-PLURAL(f)	@PLURAL(f) ¬(f PERS ANIM)	Inanimate plurals
AN-PLURAL(f)	@PLURAL(f) @ANIMATE(f) ¬(f PERS PART)	Animate 3rd person plurals
OBVIATIVE(f)	(f OBV) = + @ANIMATE(f) {@SINGULAR(f) | @PLURAL(f)}	Animate obviatives Number is ambiguous

Verb classes

Template	*Description*	*Explanation*
VTA	($\uparrow_\sigma$ ARG$_1$) ($\uparrow_\sigma$ ARG$_2$)	Two semantic arguments
VTI	($\uparrow_\sigma$ ARG$_1$) ($\uparrow_\sigma$ ARG$_2$) ¬($\uparrow$ OBJ PERS ANIM)	Two semantic arguments Object is inanimate
VAI	($\uparrow_\sigma$ ARG$_1$)	At least one semantic argument
VII	($\uparrow_\sigma$ ARG$_1$) ¬($\uparrow$ SUBJ PERS ANIM)	At least one semantic argument Subject is inanimate
INDEP-ORDER(f)	@IPC ¬(GF f)	Indep. Prominence Constraint Cannot be embedded
CONJ-ORDER(f)	@CPC (GF f)	Conj. Prominence Constraint Must be embedded

Argument mappings

Template	*Description*	*Explanation*
DIRECT	@MAP(SUBJ,ARG$_1$) @MAP(OBJ,ARG$_2$)	Subject $\mapsto$ agent Object $\mapsto$ patient
INVERSE	@MAP(SUBJ,ARG$_2$) @MAP(OBJ,ARG$_1$)	Subject $\mapsto$ patient Object $\mapsto$ agent
REFLEXIVE	@SUPPRESS(ARG$_2$,BIND(ARG$_1$))	Patient reflexively bound
SHORT-PASSIVE	@SUPPRESS(ARG$_1$,CLOSE-OFF)	Agent existentially bound

3.3 Vocabulary Items

3.3.1 Voice

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{DIRECT}\\ @\text{ADDRESSEE}(\uparrow \text{OBJ})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-in}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{DIRECT}\\ @\text{PARTICIPANT}(\uparrow \text{OBJ})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-i}$$

$$\langle\,[\text{Voice}],\quad \Phi\{\ @\text{ANIMATE}((\uparrow_{\sigma} \text{ARG}_2)_{\sigma^{-1}})\ \},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-aa}$$

$$\langle\,[\text{Voice}],\quad \Phi\{\ @\text{INVERSE}\ \},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-igw}$$

$$\langle\,[\text{Voice}],\quad \Phi\left\{\begin{array}{l}@\text{SHORT-PASSIVE}\\ @\text{PARTICIPANT}(\uparrow \text{SUBJ})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-igoo}$$

$$\langle\,[\text{Voice}],\quad \Phi\{\ @\text{REFLEXIVE}\ \},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-idizo}$$

3.3.2 Agreement[11]

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}(\uparrow \text{MINUSR}) = \%\text{GF}\\ @\text{SPEAKER}(\%\text{GF})\\ @\text{PLURAL}(\%\text{GF})\\ \{(\uparrow \text{OBJ PERS PART}) \mid \neg(\uparrow \text{OBJ})\}\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-min}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}(\uparrow \text{MINUSR}) = \%\text{GF}\\ @\text{PARTICIPANT}(\%\text{GF})\\ @\text{PLURAL}(\%\text{GF})\\ \{(\uparrow \text{OBJ PERS PART}) \mid \neg(\uparrow \text{OBJ})\}\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-m}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}\neg(\uparrow \text{SUBJ PERS PART})\\ \neg(\uparrow \text{PLUSO})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-w}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}@\text{SPEAKER}(\uparrow \text{SUBJ})\\ @\text{PLURAL}(\uparrow \text{SUBJ})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-naan}$$

$$\langle\,[\text{Agr}],\quad \Phi\left\{\begin{array}{l}@\text{PROXIMATE}(\uparrow \text{SUBJ})\\ @\text{PLURAL}(\uparrow \text{SUBJ})\end{array}\right\},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-waa}$$

$$\langle\,[\text{Agr}],\quad \Phi\{\ @\text{SHORT-PASSIVE}\ \},\_\,\rangle \quad \xrightarrow{\nu} \quad \textit{-m}$$

[11] Note that these are only the Agr heads found in the independent order.

3.3.3 Person prefixes

$\langle$ [Pers], $\Phi\{$ @HEARER(↑) $\}, \_ \rangle \xrightarrow{\nu}$ *gi-*

$\langle$ [Pers], $\Phi\{$ @PARTICIPANT(↑) $\}, \_ \rangle \xrightarrow{\nu}$ *ni-*

$\langle$ [Pers], $\Phi\left\{ \begin{array}{l} \text{@ANIMATE(↑)} \\ \text{((SUBJ ↑) PLUSO)} \end{array} \right\}, \_ \rangle \xrightarrow{\nu}$ *o-*

3.3.4 Number/obviation suffixes

(28) NUMSUFF(template) := { [(↑ OBJ) & @template(↑ OBJ)] |
[¬(↑ OBJ) & @template(↑ OBJ_θ)] |
[¬(↑ PLUSO) & @template(↑ SUBJ)] }

$\langle$ [Num], $\Phi\{$ @NUMSUFF(AN-PLURAL) $\}, \_ \rangle \xrightarrow{\nu}$ *-ag*

$\langle$ [Num], $\Phi\{$ @NUMSUFF(OBVIATIVE) $\}, \_ \rangle \xrightarrow{\nu}$ *-an*

3.3.5 Other Vocabulary Items

$\langle$ [T], $\Phi\{$ (↑ TENSE) = PST $\}, \_ \rangle \xrightarrow{\nu}$ *gii-*

$\langle$ [$\sqrt{}$], $\Phi\{$ (↑ PRED) = 'see' $\}, \_ \rangle \xrightarrow{\nu}$ *waab*

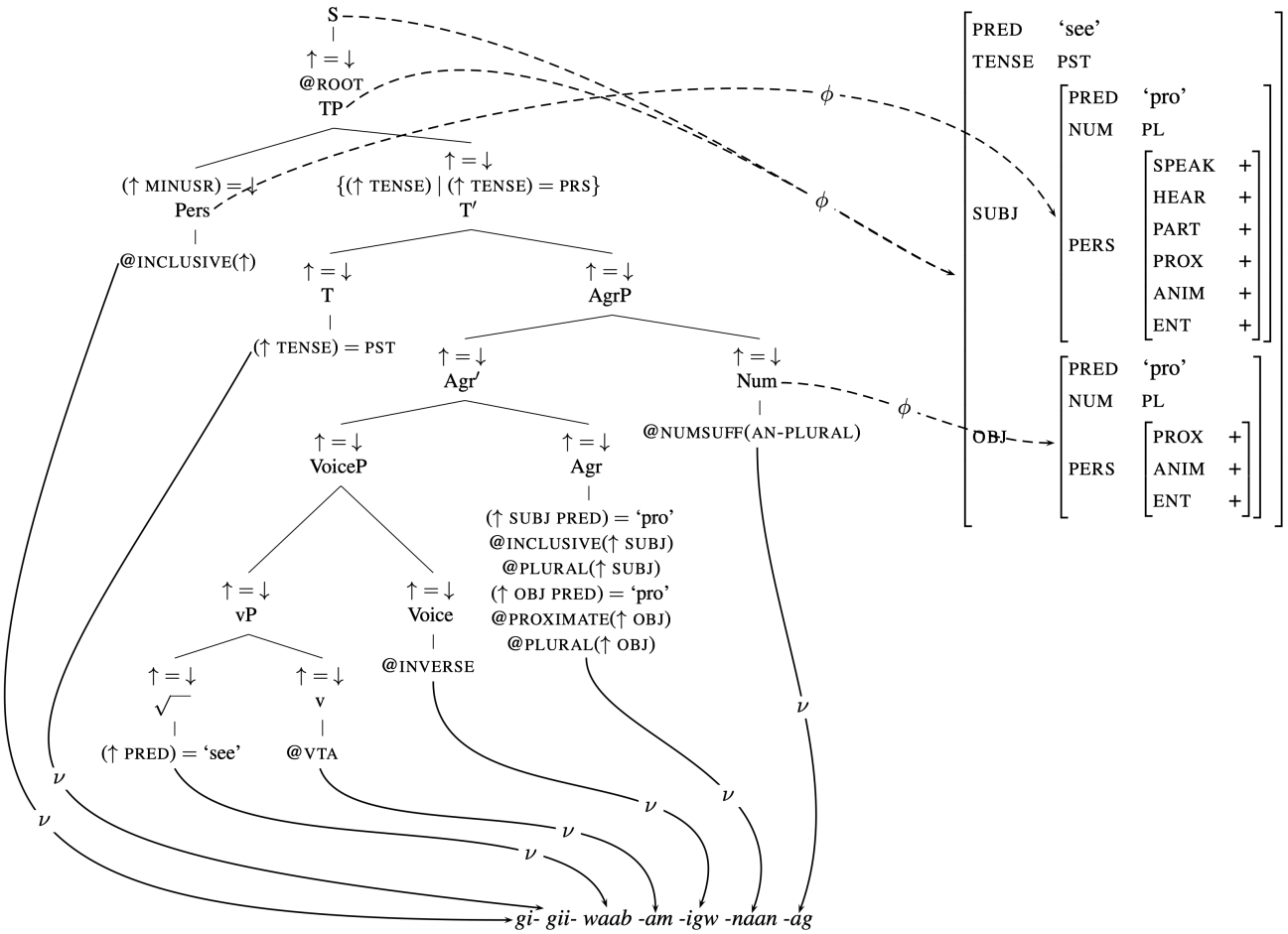
$\langle$ [v], $\Phi\{$ @VTA $\}, \_ \rangle \xrightarrow{\nu}$ *-am*

$\langle$ [$\sqrt{}$, v], $\Phi\left\{ \begin{array}{l} \text{(↑ PRED) = 'eat'} \\ \text{@VAI} \end{array} \right\}, \_ \rangle \xrightarrow{\nu}$ *wiisini*

3.4 Example

- Let's return to (1), repeated here:

(1) gi- gii- waab -am -igw -naan -ag
2 PST see VTA INV 1PL 3PL
'They saw us, including you.'



- The structures in (1) are realized by the following Vocabulary Items from § 3.3:

(29) a. $\langle$ [Pers], $\Phi\{$ @HEARER(↑) $\}, \_ \rangle \xrightarrow{\nu}$ *gi-*

b. $\langle$ [T], $\Phi\{$ (↑ TENSE) = PST $\}, \_ \rangle \xrightarrow{\nu}$ *gii-*

c. $\langle$ [$\sqrt{\ }$], $\Phi\{$ (↑ PRED) = 'see' $\}, \_ \rangle \xrightarrow{\nu}$ *waab*

d. $\langle$ [v], $\Phi\{$ @VTA $\}, \_ \rangle \xrightarrow{\nu}$ *-am*

e. $\langle$ [Voice], $\Phi\{$ @INVERSE $\}, \_ \rangle \xrightarrow{\nu}$ *-igw*

f. $\langle$ [Agr], $\Phi\left\{ \begin{array}{l} \text{@SPEAKER(↑ SUBJ)} \\ \text{@PLURAL(↑ SUBJ)} \end{array} \right\}, \_ \rangle \xrightarrow{\nu}$ *-naan*

g. $\langle$ [Num], $\Phi\{$ @NUMSUFF(AN-PLURAL) $\}, \_ \rangle \xrightarrow{\nu}$ *-ag*

4 Semantic inputs to exponence: Morphosemantics

- How is morphosemantics distinct from general lexical semantics?
  - We regard morphosemantics as encompassing all and only aspects of meaning that affect the mapping from a semantic representation to a phonological representation.
    - In L_RFG terms, this is those meanings that condition the mapping to v-structure.
    - The principle that governs this mapping, formalized in (19) below, is **MostInformative**$_s$.

1. Semantically conditioned morphology — morphemes which have semantic wellformedness conditions on their base

   (30) *re-establish*

2. Polysemy — morphemes which can appear in a wide variety of semantic and functional environments

   (31) *keep*

3. Lexicalization — complex morphological forms, consisting of seemingly productive morphology, that do not necessarily have the compositionally predicted meanings

   (32) *antsy*

   (33) *lousy*

4. Irregulars/regulars — extant pairs of regular and irregular forms where one form contains more specialized meaning

   (34) *brethren/brothers*

   (35) *unkempt/uncombed*

   (36) *divinity/divineness*

   (37) *cómparable/compárable*

- This phenomenon is of particular interest to morphological theory because it represents a failure of *blocking* (Aronoff 1976).
  - It is typically the case that irregular allomorphs block their regular counterparts.
  - This is exactly how we know that the relevant alternation is one of irregular allomorphy and not synonymy (for discussion, see Siddiqi 2021).
    - For example, we know that *ran* is an allomorph of *run* precisely because **runned* is blocked.
    - We are not sure that *raise* is an allomorph of *rise* (despite a similar irregular morphological process) because there is no allomorph that is blocked.
    - Similarly, it is debatable whether *people* is the plural of *person*, precisely because *persons* is licit in some environments (Arregi and Nevins 2013).

- This blocking of regular allomorphs is typically inviolate, especially in high frequency words and also especially in uncontroversially inflectional morphology (*ate*/*went* always blocks **eated*/**goed*), but it's not the case that both conditions are required:

  1. High frequency irregular derivational morphology can easily block.

     (38) Ojibwe irregular *miiji* 'eat.TRANSITIVE.ANIMATE' blocks regular **amw-dan*.

2. Low frequency irregular inflection keeps its power to block.

   (39) English *oxen* blocks **oxes* despite the infrequency of the former.

- It has been well-known since at least Aronoff (1976) that blocking of regular, fully productive forms can fail and that both irregulars and regulars can exist in parallel, in some circumstances.
  - Aronoff (1976) has in some ways become the base way that we conceptualize blocking.
  - In that approach, *glory* blocks *gloriosity* (and similarly *to sweep* blocks *to broom*) because the output of irregular morphological processes (such as suffixation of *-ity*) need to be stored in a certain semantic space.
  - That space in the context of *gloriosity* is occupied by *glory*.
  - However, perfectly productive and transparent morphological processes (such as suffixation of *-ness*) do not need to be stored because their meanings are completely predictable, so they cannot be blocked.
  - Thus, *glory* does not block *gloriousness*.
- In contemporary realizational morphological theory, failures of blocking are especially relevant.
- In realizational models, blocking falls naturally out of the core mechanism of the grammar.
- From a certain point of view, all morphemes are allomorphs of all other morphemes that they are in competition with.
- Allomorphy in these approaches is crucially conceptualized differently from the traditional Aronoff (1976) approach.
- Morphological forms *express* underlying meaning rather than contributing meaning. In some sense, *run* and *sneeze* are allomorphs of each other in expressing the underlying feature of being a verb.
  - It is information beyond being a verb that determines which exponent is realized, such as expressing a meaning *run′* rather than *sneeze′*.
    - For example, where the meaning *run′* is being expressed, *run* blocks *sneeze*, and vice versa.
    - From the same point of view, *una* (‘D.INDEF.FEM’, Spanish) blocks *un* (‘D.INDEF’) in *una mujer* (‘a woman’) because the allomorph *una* expresses more information.
- Thus, the winner of any given competition effectively blocks the rest.
- This is a general point about realizational morphology — not just lexical-realizational approaches like DM/L_RFG, but also inferential-realizational models such as Paradigm Function Morphology (Stump 2001).
- Put simply, realizational rules are fundamentally Paninian, meaning the most specific will apply in a given context, thus preferring portmanteau forms over general forms.
- This interaction of grammatical architecture and blocking is discussed at length in Embick and Marantz (2008).
- Both these approaches to blocking are in some ways ‘wrong’ in that they both incorrectly predict extremes.
  - Realizational blocking expects blocking to *always* happen, and Aronovian blocking expects complete blocking of productive morphology to *never* happen.
  - Here the focus is on the conditions under which blocking fails such that we get both a regular and irregular form.

- So the basic question is the following:

  Q: If X, an irregular form, is a more specific form of Y, a regular form, how can X fail to block Y?

- For example, if *divinity*/*curiosity*/*productivity* is a more specific form of respectively *divineness*/*curiousness*/*productiveness*, why are the latter not blocked by the relevant instantiation of the Paninian principle?

- We ground our analysis in the generalization that, in such cases (as discussed above), the irregular expresses non-compositional meaning and thus is not in competition with the regular.

- However, in contexts where the regular and irregular are deployed with the same intended meaning, the irregular should indeed block the regular.

- In L_RFG, exponence has access to compositional semantics — i.e., the *actual* semantics, rather than 'feature semantics' or some other ad hoc syntactic markup — and any pragmatic place-holder variables (as in, e.g., Partee and Borschev 2003).

- This allows for a more precise and nuanced type of analysis, making L_RFG perhaps unique among Lexical-Realizational models of morphology.

4.1 Analysis

- The cases we are looking at here all concern a specific kind of stem allomorphy.
  - Namely, they are all putative cases of regular and irregular forms in competition, where both the regular and the irregular are grammatical.
  - In these cases, a common view is that the irregular contains more specialized meaning than the regular, as a function of portmanteaus in the grammar (see, e.g., Aronoff 1976 et seq.) and whole word storage in processing (see, e.g., Baayen 1992 et seq.).

4.1.1 *Divinity/divineness*

- The regular/productive form *divineness* is a word that expresses a (positive) quality.

  (40) This chocolate is divine but is affordable despite its divineness.

- The irregular form *divinity*, at least for most native speakers, also involves some notion like "holiness".

  (41) !This chocolate is divine but is affordable despite its divinity.

  (42) This communion wafer is divine but is bland despite its divinity.

  - Example (41) is odd, because it attributes the quality of holiness to chocolate, which does not accord with common world knowledge.
  - On the other hand, (42) accords with our world knowledge, since (in the requisite theology) communion wafers are indeed holy.

- The following examples illustrate that *divinity* contains a weaker notion of goodness than *divineness*.

  (43) Cthulhu's divinity/#divineness is terrible to behold.

  (44) In *His Dark Materials*, Metatron is evil despite his divinity/#divineness.

  (45) Theologians have long been puzzled by why God allows evil to happen despite his divinity/divineness.

- It seems that *divine* asserts goodness and, in a different but related usage, can also assert the possibility of holiness.
- *Divineness* inherits these possible meanings, since the regular affix *-ness* only modifies category, not meaning.
- In contrast, *divinity* asserts only the possibility of goodness and also necessarily asserts holiness.

- The relevant meanings can be represented something like this:

(46) $[\![\textit{divineness}]\!]$ = **good**
or $[\![\textit{divineness}]\!] = \lambda x.\textbf{good}(x) \wedge \Diamond\textbf{holy}(x)$

(47) $[\![\textit{divinity}]\!] = \lambda x.\Diamond\textbf{good}(x) \wedge \textbf{holy}(x)$

- In a c-structure, where the Glue meaning constructor forms part of the input to exponence, if the relevant meaning constructor is $\lambda x.\Diamond\textbf{good}(x) \wedge \textbf{holy}(x)$, this can only be realized as *divinity*.
- If *divineness* is chosen by the speaker, by implicature the hearer will conclude that the speaker intended to communicate either only the property of goodness or a stronger notion of goodness jointly with holiness, since had the speaker wished to communicate only the joint properties of possible goodness and holiness, they ought to have chosen *divinity*.

- The relevant Vocabulary Items are the following:

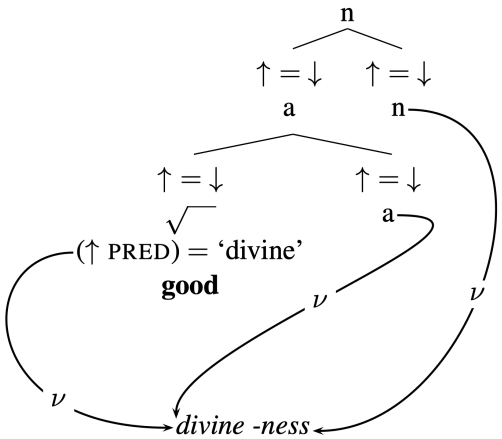
(48) $\langle$ [$\sqrt{\ }$, a], Φ\{(↑ PRED) = 'divine'\}, {**good**, $(\lambda P\lambda x.P(x) \wedge \Diamond\textbf{holy}(x))$} $\rangle$
$\xrightarrow{\nu}$ *divine*

(49) $\langle$ [n], Φ\{ \}, { } $\rangle$ $\xrightarrow{\nu}$ *-ness*

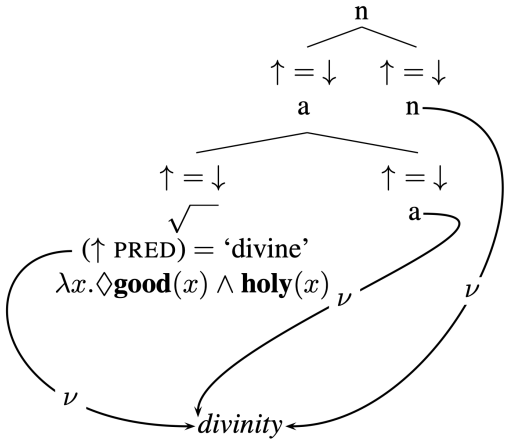
(50) $\langle$ [$\sqrt{\ }$, a, n], Φ\{(↑ PRED) = 'divine'\}, $\{\lambda x.\Diamond\textbf{good}(x) \wedge \textbf{holy}(x)\}$ $\rangle$
$\xrightarrow{\nu}$ *divinity*

- Examples (51) and (52) show that if *divine* is interpreted as contributing only the property of goodness, then *divineness* can co-exist with *divinity*, since neither entails the other.
  - Similarly, if the optional meaning constructor for *divine* is in the structure, then the meaning being expressed is $\lambda x.\textbf{good}(x) \wedge \Diamond\textbf{holy}(x)$, which again neither entails nor is entailed by the meaning expressed by *divinity*.

(51)



(52)



- Here we see that the presence in (52) of *divinity* (rather than *divineness*) is mandated by **MostInformative**$_s$, which selects for *divinity* because it is a portmanteau over the Glue meaning term **holy**.

- In (51), on the other hand, while the first member of *divinity*'s V^i triple is satisfied (all three categories are present) — as are all the requirements of the second member of V^i — the absence of **holy** or the presence of only insufficient ◇**holy** in the third member of the triple fails to license the presence of *divinity*.

⇒ Thus, the more complex candidate *divineness* is licensed.

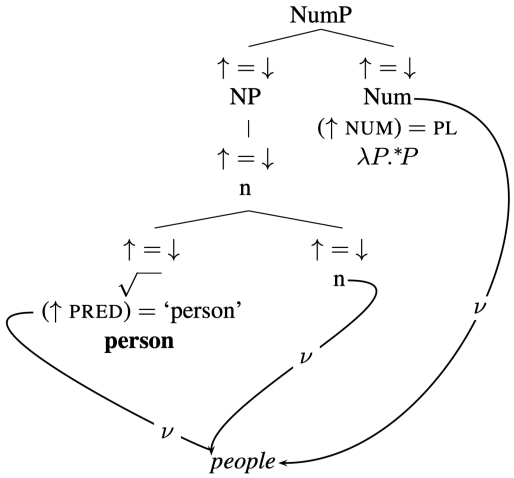
4.1.2 *People/persons*

- At first blush, *people/persons* appears to be similar to *divinity/divineness*.
- While it is often argued that *people* is not actually a suppletive plural for *person* (see discussion in Siddiqi 2021), let's set that debate aside and assume that *people* in fact does express [PRED 'person'].
- This case is particularly interesting: For some speakers for whom *people* is the unambiguous plural of *person*, it is actually *persons* — the seeming regular — which has specialized meaning!
- It appears only in highly formal contexts/registers.

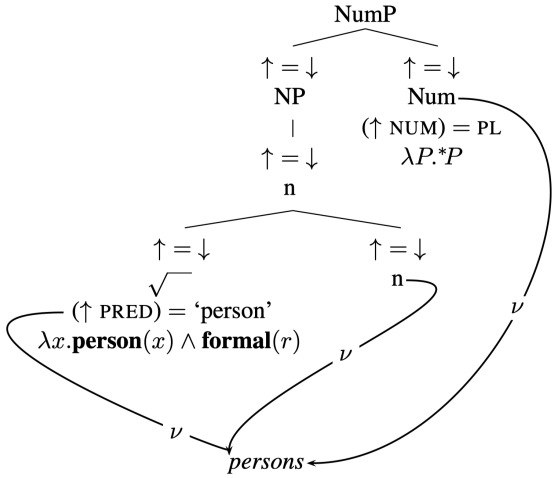
(53) a. In cases of missing persons, the police search for missing people.
b. Indigenous people should contact the Indigenous Persons Bureau.
c. This room's capacity is 25 people, which is why there is a sign that says "Max 25 Persons".

- This highly specialized meaning is evidence for the claim that *persons*, despite its seemingly regular morphology, is indeed a portmanteau (see Haugen and Siddiqi 2016).
- Further evidence for this claim is the fact that *persons* is legal in compounds (e.g., Missing Persons Department; see Siddiqi 2009 for discussion).
- Therefore, *persons* and *people* are in fact *both* portmanteau forms realizing the same c-structural and f-structural spans, as seen here in (54) and (55).[12,13]

(54)



(55)



⇒ Thus, it is only **MostInformative**$_s$ that selects *persons* over *people*, and only in formal registers.

[12] We do not show the Vocabulary Items here, but they can be inferred from the c-structures in (54) and (55).
[13] We assume a mereological plural meaning, following Link (1983): $\lambda P.{}^*P$

4.1.3 *Brethren/brothers*

- Let's lastly consider the case of *brethren/brothers*.
- Again at first blush, we expect another *divinity/divineness* analysis.
- Instead we see that this requires a much more nuanced semantic account.
- Following Partee and Borschev (2003), we assume that a relational noun like *brother* involves a relation between the nominal entity and some other entity, such as a possessor.
- The meaning term for *brother* can be represented as follows:

  (56) $\lambda y \lambda x \lambda R.\textbf{male}(x) \wedge R(x, y)$

  - Notice that, in an utterance where this is unresolved, the relational variable, R, is filled from context.
  - In sum, (56) is the meaning term from the one *obligatory* meaning constructor for *brother*.
- Of course, the relation **sibling** is always available in the null context.
- So we assume that there is a second, optional meaning constructor for *brother* whose meaning term modifies the term in (56) as follows:

  (57) $\lambda R.R(\textbf{sibling})$

  - Thus, the interpretation of male sibling is available without context, but other interpretations are available if context and pragmatic knowledge supports them.
  - In other words, as the term in (57) is optional, R in (56) can instead be instantiated contextually/pragmatically, for example as **close.friend** (where culturally appropriate, which is evidence of its pragmatic nature).
- Here are the Glue terms from the VI for *brother*:

  (58) $\lambda y \lambda x \lambda R.\textbf{male}(x) \wedge R(x, y)(\ \lambda R.R(\textbf{sibling})\ )$

  - The optional meaning is thus available, and provides the interpretation in the null context.
  - Alternatively, the pragmatic context fills in the R, such as in the case of **close.friend**.
  - Indeed, *brother* can also be the singular of *brethren*, with the relevant meaning, as in the favoured reading, outside of other context, of a monk saying of another monk at the same monastery:

  (59) My brother spoke out of turn.
- In contrast, *brethren* obligatorily expresses the following relational meaning constructor in addition to the general meaning in (56) and the plural meaning (see footnote 13 above):

  (60) $\lambda R.R(\textbf{member.of.same.order})$

  - So *brethren* denotes the members of an all-male order.
  - For speakers for whom the group must be a religious order, the meaning can be suitably further restricted.

- We now have what we need to list the three VIs in this competition:

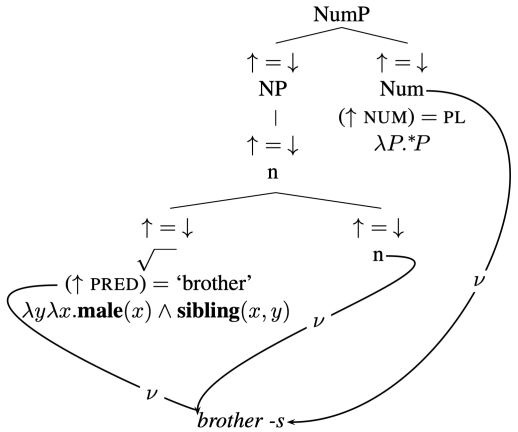
(61) $\langle$ [$\sqrt{\ }$, n], Φ\{(↑ PRED) = 'brother'\}, \{$\lambda y \lambda x \lambda R.$**male**$(x) \wedge R(x,y), (\lambda R.R($**sibling**$))$\} $\rangle$ $\xrightarrow{\nu}$ *brother*

(62) $\langle$ [Num], Φ\{(↑ NUM) = PL\}, \{$\lambda P.{}^*P$\} $\rangle$ $\xrightarrow{\nu}$ *-s*

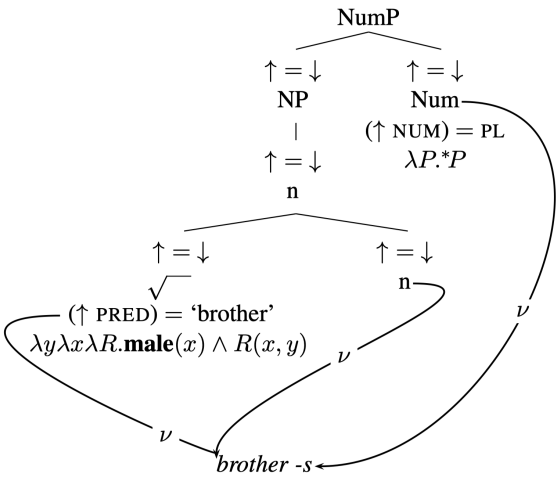
(63) $\langle$ [$\sqrt{\ }$, n, Num], Φ\{(↑ PRED) = 'brother'\}, \{$\lambda y \lambda x.$**male**$(x) \wedge$ **member.of.same.order**$(x,y), \lambda P.{}^*P$\} $\rangle$ $\xrightarrow{\nu}$ *brethren*

- In sum, as you can see in (64) and (65), *brothers* is licensed because either the relationship is fully specified as male sibling or appears underspecified, allowing for contextual specification of R.
- This underspecified R may resolve as male sibling due to pragmatic forces, but it need not; it could resolve to close friend, among other possibilities.

(64)

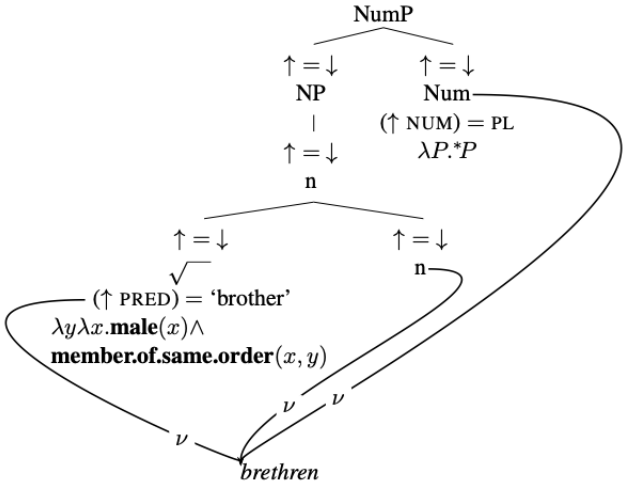


(65)



- *Brethren* is disallowed in both (64) and (65) because of the absence of **member.of.same.order**.
- Thus, licensing of *brethren* fails despite the fact that **MostInformative**$_c$ would prefer *brethren* over *brothers*, because *brethren* is a portmanteau over Num.
- On the other hand, in (66), **member.of.same.order** is specified in the c-structure, so **MostInformative**$_s$ and **MostInformative**$_c$ together select *brethren* over *brothers*.

(66)



- Since the Root node containing [PRED 'brother'] can come to have the meaning **member.of.same.order** through two means — overt specification and contextual specification — we make a correct prediction about morphosemantics here: The word *brothers* can be used with the same meaning as *brethren* when the meaning is contextually available, as when a monk might equivalently say (67) or (68).

  (67) My brethren will make sure you are comfortable.

  (68) My brothers will make sure you are comfortable.

- However, the latter utterance could instead have other contextual meanings.

⇒ Thus, if the monk wished to communicate specifically that the members of the order will ensure the addressee's comfort, *brethren* would be a better choice than *brothers*, because *brethren* has a more specific meaning.

4.2 Summary

- Our goal in the morphosemantic component of the L_RFG project is to use the actual compositional semantics to make morphological predictions.
  - We use the meaning constructors from Glue Semantics to accomplish this.
  - This yields a nice result with respect to *locality*: meaning constructors are anchored to particular f-structures and thus only take scope over their f-structural anchor.
  - We essentially get semantic locality for free: there simply is no question of being able to look "outside your domain" for a relevant feature, and therefore no need to place extra limits on processes for matching features and their probes, as in non-LFG-based DM.
  - L_RFG has the capacity to use Glue terms in its Vocabulary Items, so it can capture morphosemantics directly, in contrast to DM approaches built on the 'Y model' (Chomsky 1981, 1995), in which syntax feeds LF and PF separately and there is therefore no direct interface between semantics and form.

5 The output of exponence: Morphophonology and the input to prosody

- This is the general output that I will motivate:

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

$$\begin{bmatrix} \textsc{phon(ological)} & \\ \textsc{rep(resentation)} & \textit{phonological realization \& conditions} \\ \textsc{p(rosodic)frame} & \textit{prosodic unit} \\ \textsc{p(rosodic)level} & 1 \mid 2 \\ \textsc{dep(endence)} & \left\{ \textsc{lt}, \textsc{rt} \right\} \\ \textsc{class} & \left\{ \textit{inflectional classes} \right\} \\ \textsc{type} & \textsc{verbal} \mid \textsc{nominal} \mid \textsc{adjectival} \\ \textsc{host} & \begin{bmatrix} \textsc{ident(ity)} & \textsc{aunt} \mid \textsc{niece} \\ \left\{ \textit{v-s} \begin{bmatrix} \textsc{phon.rep} & \ldots \\ \textsc{pframe} & \ldots \\ \textsc{plevel} & \ldots \\ \textsc{dep} & \ldots \\ \textsc{class} & \ldots \\ \textsc{type} & \ldots \end{bmatrix} \right\} \end{bmatrix} \end{bmatrix}$$

- This is the Vocabulary Item (VI) for *-en* that I will motivate:[14]

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

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

5.1 Phonological Features

5.1.1 Phonological Representation

- PHON.REP states the output phonological form and any conditions on mapping to it.
  - 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.

[14] I 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*}].

5.1.2 Prosodic Frame

- PFRAME states 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.

5.1.3 Prosodic Level

- PLEVEL 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).

5.1.4 Dependence

- DEP states 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.

5.2 Morphological features

5.2.1 Class

- This is for inflectional class and would be where we would attempt to capture *morphomes* (Aronoff 1994, Bermúdez-Otero and Luís 2016, Maiden 2018).
  - For example, this is where we would capture verb classes and noun classes, such as Latin declensions and conjugations.

5.2.2 Type

- The possible types are verbal, nominal, and 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 $\overset{\nu}{\rightarrow}$.
  - For example, Infl, Tense, AgrS, AgrO, Voice, and Aspect are all distinct categories in the first/c-structure coordinate of the input to $\overset{\nu}{\rightarrow}$.
    - However, if they are specified with a TYPE feature on the output side, it is [TYPE VERBAL].[15]

[15] 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.

- 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.

5.3 Morphosyntactic features

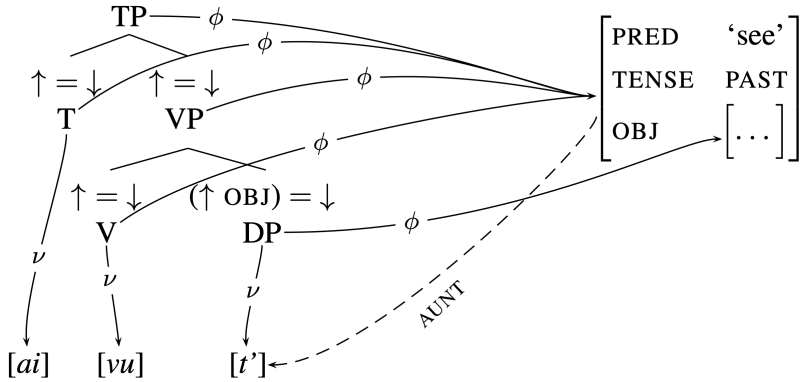
5.3.1 Host

- 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.

Identity

- This captures 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.

(71)

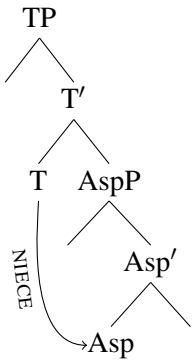


- For example, this is how we would capture object clisis in Romance languages.

(72) 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.

(73)



  - In this tree, NIECE(ASP) = $\rho(\nu(\lambda^{-1}(\text{Asp})))$.[16]
  - For example, this is how we would capture typical inflectional affixation, such as in the verbal spine.

5.4 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).

(74) 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*.

[16] 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.

5.5 DEPENDENCY & HOST: Classifying forms

1. Free form

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

2. Clitic_a (leaners/simple clitics)

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

- 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.

(77) English possessive *'s*

a. The car's fender

b. The car you are in's fender

(78) 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)

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

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

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

(81) 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 (75) above.

5. Affix

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

(82)
$$\begin{bmatrix} \text{PHON.REP} & \dots \\ \text{PFRAME} & \dots \\ \text{DEP} & \dots \\ \text{HOST} & \begin{bmatrix} \text{IDENT} & \text{NIECE} \end{bmatrix} \end{bmatrix}$$

- 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].

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

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

  (84) *unnatural*
  English morpheme-boundary geminate

5.5.1 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

5.6 Analysis

- 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*.[17]
   ∴ [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 5.2.2 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).[18]
     - 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]}]

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

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

[17] 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.

[18] 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.

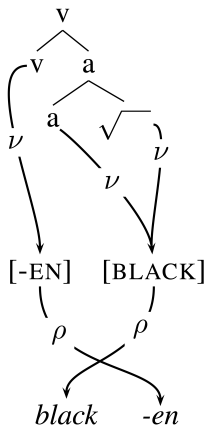
- Using • to represent "this v-structure" and · to represent "the p-structure correspondent of this v-structure" (i.e., $\rho(\bullet)$), the equivalent description is shown in (86). Note that the set membership symbol, $\in$, is used here in a standard LFG way to indicate a path that goes into a set.

(86) (• 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:

(87)



- 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.
  - Thus, we get the following contrasts:

    (88) a. The tomatoes reddened/*redded in the sun
    b. The newspapers *yellowened/yellowed in the sun.
    c. The meat *grayened/grayed in the sun.
    d. The bananas *yellowened/yellowed and then blackened/*blacked in the sun.
    e. The maple leaves reddened/*redded and then *brownened/browned in the sun.

Conclusion

- L_RFG has only been around a few years, but it seems to offer some interesting prospects.
  - Of course, I'm biased!
- The framework is a synthesis of LFG and DM, which is interesting in its own right due to its perhaps unlikeliness.
  - But why is it unlikely? It seem to us that the barrier is mainly that the constraint-based and derivational communities have drifted so far apart, so perhaps L_RFG can offer a kind of bridge between them.
- It's important to separate the L_RFG *framework*, which is ultimately just a way to do lexical-realizational morphology using LFG tools, from L_RFG *theories*, which use the framework for precision and prediction.
  - Our own current L_RFG theory consists of our architectural assumptions (repeated in Figure 2 below), our assumptions about the exponence function, ν, and four interacting principles:
    1. **MostInformative**$_f$: Whenever possible, prefer portmanteau forms. Choose the Vocabulary Item that defines an f-structure that contains the greater set of features.
    2. **MostInformative**$_c$: Whenever possible, prefer portmanteau forms. Choose the VI that realizes the greater set of categories.
    3. **MostInformative**$_s$: Whenever possible, prefer portmanteau forms. Choose the VI whose denotation is more semantically contentful.
    4. **MostSpecific**: Whenever possible, prefer affixes. Choose the VI whose output v-structure has more specific content in the HOST feature.
  - L_RFG captures the theoretical content of DM in the principles above. However, it formalizes its theory in terms made available by LFG.
- This talk has particularly focused on the exponence function, ν.
  - The formal tools we inherit from LFG allow us to state the inputs of this function precisely, in syntactic (c-structural and f-structural) and semantic terms. Moreover, the semantics is real, compositional semantics.
  - The same formal tools allow us to state the output of the function precisely. The output is a complex feature structure, called a *v-structure*, which is an interface between syntax/semantics and prosody/phonology.

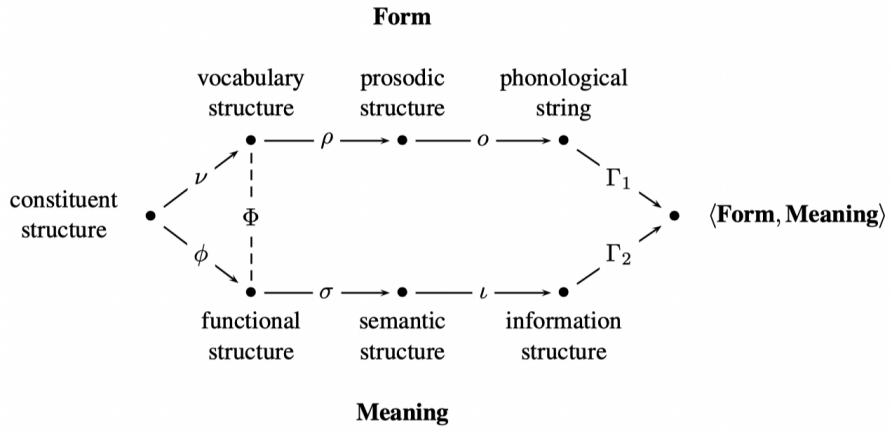


Figure 2: L_RFG's correspondence architecture

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