Capturing generalizations about exponence

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What is exponence? I

- **Exponence relations** within a paradigm:
  Some phonological property is present in some proper subpart of the paradigm.

  - Spanish adjective BUENO ‘good’:
    - ‘last vowel is /a/’ ⇔ FEM
    - ‘last vowel is /o/’ ⇔ MAS
    - ‘ends in /s/’ ⇔ PL

  - The relevant phonological property does not always amount to containing a specific substring
    - ‘does not end in /s/’ ⇔ SG

  ‘zero exponence’
What is exponence? II

- The relevant phonological property does not always amount to containing a specific substring
  - German noun MUTTER ‘mother’:
    - ‘nonfront vowel in first syllable’ ⇐ SG
    - ‘front vowel in first syllable’ ⇐ PL

- The relevant content is not always coherent
  - French verb FINIR ‘finish’:
    |      | 1SG | 2SG | 3SG | 1PL | 2PL | 3PL |
    |------|-----|-----|-----|-----|-----|-----|
    | SBJV.PRS | finis | finis | finis | finisjɔ̃ | finisje | finis |
    | IND.PRS | fini | fini | fini | finiǥ | finise | finis |
    | IND.FUT | finiʁɛ | finiʁa | finiʁa | finiʁɔ̃ | finiʁe | finiʁɔ̃ |

- ‘ends in /is(j)(V)/’ ⇐ IND.PRS.PL ∨ SBJV.PRS ∨ ⋯
- ‘ends in /i(ʁ)(V)/’ ⇐ IND.PRS.SG ∨ IND.FUT ∨ ⋯
Constructive approach to exponence

▶ In this talk I will pursue a constructive approach to exponence in the sense of Blevins (2006), where we express generalizations within a formal grammar that licenses wordforms on the basis of explicit abstract primitives.

▶ This presupposes that:
  ▶ We have a pre-established segmentation of words into stems and affixes.
  ▶ Stem alternants as well as affixes may have exponential value.
  ▶ We have a pre-established statement of the exponential value of each element.

▶ This is definitely not the only fruitful way to reason about exponence; see remarks at the end of the talk.
Information-based morphology (IbM)

- IbM is a relatively novel formal framework for the analysis of inflection systems developed by Berthold Crysmann and myself (Crysmann and Bonami, 2016; Bonami and Crysmann, 2016, 2018; Crysmann and Bonami, 2017; Crysmann, 2017)

- IbM combines insights from
  - Inferential-realizational theories (Matthews, 1965; Anderson, 1992; Stump, 2001; Brown and Hippisley, 2012)
  - HPSG (Pollard and Sag, 1994), and in particular the modelling techniques for morphology introduced by Koenig (1999)

- Important design goals for IbM:
  - Nonreductionist: direct expression of generalizations.
  - Incorporate explicit insights from morphological typology
    - Deviations from the canon correspond to measurable addition of formal complexity.
  - Maintainable grammars: avoidance of rule cascades (AM, PFM) and stipulated defaults (NM)
  - Explicit interface to theories of phonology, syntax and semantics
1. Capturing word-level generalizations about exponence
   ▶ Wordforms as lists of indexed morphs
   ▶ Rules of exponence as many-to-many generalizations
   ▶ Hierarchies of rule types (a.k.a schemas)
2. Capturing lexeme-level generalizations about exponence
   ▶ Paradigm identifiers and rules of stem introduction
   ▶ Inflection classes
   ▶ Hybrid classes: overabundance and heterooclisis
3. Outlook: questioning presuppositions
Capturing word-level generalizations about exponence

I. Motivation
Variable morphotactics I

- Crysmann and Bonami (2016) documents the prevalence and theoretical importance of variable morphotactics.

  - Conditioned placement: Portuguese pronominal affixes

<table>
<thead>
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<th></th>
<th>Past Imperfective</th>
<th>Conditional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No praff affix</td>
<td>2SG.ACC affix</td>
</tr>
<tr>
<td>1SG lav-a-va</td>
<td>lav-a-va-te</td>
<td>lav-a-r-ia</td>
</tr>
<tr>
<td>2SG lav-a-va-s</td>
<td>lav-a-va-s-te</td>
<td>lav-a-r-ia-s</td>
</tr>
<tr>
<td>3SG lav-a-va</td>
<td>lav-a-va-te</td>
<td>lav-a-r-ia</td>
</tr>
<tr>
<td>1PL lav-á-va-mos</td>
<td>lav-á-va-mos-te</td>
<td>lav-a-r-ía-mos</td>
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<tr>
<td>2PL lav-á-ve-is</td>
<td>lav-á-ve-is-te</td>
<td>lav-a-r-íe-is</td>
</tr>
<tr>
<td>3PL lav-a-va-m</td>
<td>lav-a-va-m-te</td>
<td>lav-a-r-ia-m</td>
</tr>
</tbody>
</table>

- Free placement: Mari possessives

<table>
<thead>
<tr>
<th></th>
<th>Absolute</th>
<th>1PL Possessed</th>
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<tbody>
<tr>
<td></td>
<td>Poss &lt; Case</td>
<td>Case &lt; Poss</td>
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</tbody>
</table>

<table>
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<th>DAT</th>
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<td>pört-əm</td>
<td>pört-lan</td>
<td>pört-eš</td>
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<tr>
<td></td>
<td>pört-na</td>
<td></td>
<td>pört-na-m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pört-na-lan</td>
<td>pört-lan-na</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pört-eš-na</td>
</tr>
</tbody>
</table>
Reasoning on such variable morphotactic situations is much more direct and straightforward if we recognize explicitly the notion of a morph occupying a position (Luís and Spencer, 2005).

Importantly, Anderson’s 1992 arguments against morphousness do not apply to IbM.
The $m : n$ format of rules of exponence

- Basic insight from Matthews (1972): widespread noncanonical exponence.
  - simple exponence (1 morph : 1 property) vs.
  - cumulative exponence (1 morph : $n$ properties) vs.
  - (fully redundant) multiple exponence ($m$ morphs : 1 property) vs.
  - overlapping exponence ($m$ morphs : $n$ properties)

- Most approaches to inflection take a reductionist approach to multiple exponence, by having separate rules (or morphemes) introducing overlapping (or identical) content.

- IbM adopts a much more direct approach to the typology of exponence:
  - The general format of rules of exponence is $m : n$, defining a large space of exponence types.
The $m : n$ format of rules of exponence II

French *iront* ‘they will go’

{ 'go', FUT, 1PL }

\[
\begin{array}{c}
  r_1 \\
  r_2 \\
  r_3 \\
  \langle i_0, v_2, \ddot{\varsigma}_4 \rangle
\end{array}
\]

German *getanzt* ‘danced’

{ 'dance', PPP }

\[
\begin{array}{c}
  r_1 \\
  r_2 \\
  \langle \text{ge}^{-1}, \text{tanz}_0, t_1 \rangle
\end{array}
\]

English *(l) go*

{ 'go', PRS, 1SG }

\[
\begin{array}{c}
  r_1 \\
  \langle \text{go}_0 \rangle
\end{array}
\]

- General principles:
  - An inflected word associates a list of morphs with a property set
  - Each morph has to be licensed by a rule
  - Each property that can be expressed by a morph must be expressed

- Important notes:
  - ‘Rules’ here are declarative statements on the cooccurrence of bits of forms and bits of content, not procedural rules.
    - Standard usage in realisational morphology
The \( m : n \) format of rules of exponentence III

▶ The framework is compatible with the formulation of grammars that introduce all exponents holistically.

▶ Consider the Persian past:

<table>
<thead>
<tr>
<th></th>
<th>1SG</th>
<th>2SG</th>
<th>3SG</th>
<th>1PL</th>
<th>2PL</th>
<th>3PL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>xaridam</td>
<td>xaridi</td>
<td>xarid</td>
<td>xaridim</td>
<td>xaridid</td>
<td>xaridadand</td>
</tr>
<tr>
<td>IPFV</td>
<td>mixaridam</td>
<td>mixaridi</td>
<td>mixarid</td>
<td>mixaridim</td>
<td>mixaridid</td>
<td>mixaridadand</td>
</tr>
</tbody>
</table>

Past indicative forms of XARIDAN « buy »

▶ The formal framework does not stop us from hypothesizing:

\[
\begin{align*}
\{ \text{buy, } \text{PFV, } 1\text{PL} \} & \quad \{ \text{buy, } \text{IPFV, } 1\text{PL} \} \\
\{ \text{buy, } \text{PFV, } 1\text{PL} \} & \quad \{ \text{buy, } \text{IPFV, } 1\text{PL} \}
\end{align*}
\]

▶ Better analysis (descriptive economy (6 vs. 11 rules), expression of generalizations):

\[
\begin{align*}
\{ \text{buy, } \text{PFV, } 1\text{PL} \} & \quad \{ \text{IPFV, } \text{buy, } 1\text{PL} \} \\
\{ \text{buy, } \text{PFV, } 1\text{PL} \} & \quad \{ \text{IPFV, } \text{buy, } 1\text{PL} \}
\end{align*}
\]
Many systems exhibit important generalizations over rules of exponence.

- Exponents of different values of the same feature share the same placement properties
- Morphologically-conditioned allomorphs partially share the same shapes
- Polyfunctionality: series of exponents of related feature values shared across morphosyntactic domains
- etc.

Important insight (Anderson, 1992; Stump, 2001): these are not linguistic universals, and hence should not be hard-coded by the theoretical framework.

That being said, it is important for an adequate framework to have simple means of expressing such generalizations where they are empirically valid.
Generalizations over rules II

- IbM relies heavily on inheritance hierarchies of rules of exponence to that effect.
- Simple example from Persian:

```
rule-exp
{IPFV} : ⟨mi-1⟩  ...  {PER.NUM} : ⟨affix₁⟩
{1SG} : ⟨-am₁⟩  {2SG} : ⟨-i₁⟩  {1PL} : ⟨-im₁⟩  {2PL} : ⟨-id₁⟩  {3P} : ⟨-and₁⟩
```
Capturing word-level generalizations about exponence

A sketch of IbM
Words in IbM

- Morphological representation of a word:

  \[
  \begin{align*}
  \text{MORPHOSYNTAX} & \quad \{ [\text{PID} \; \text{setzen}] [\text{TMA} \; \text{ppp}] \} \\
  \text{MORPHS} & \quad \langle [\text{PH} \; <\text{ge}>] [\text{PH} \; <\text{setz}>] [\text{PH} \; <\text{t}>] \rangle \\
  \text{PHONOLOGY} & \quad <\text{gesetzt}> 
  \end{align*}
  \]

- Rules as abstractions over words:

  \[
  \begin{align*}
  \text{MS} & \quad \{ [\text{TMA} \; \text{ppp}],... \} \\
  \text{MPH} & \quad \langle [\text{PH} \; <\text{ge}>] [\text{PH} \; <\text{t}>] \rangle,... \rangle 
  \end{align*}
  \]
The feature RR keeps a record of which rules license a particular wordform.
Hierarchies of rules

- Rules are descriptions of typed feature structures organized in (monotonous) multiple inheritance hierarchies.
- Monodimensional inheritance captures simple generalizations over rules:

\[
\begin{align*}
\text{MS} & \quad \left\{ \begin{bmatrix} \text{TMA} & \text{ppp} \end{bmatrix} \right\} \\
\text{MPH} & \quad \left\{ \begin{bmatrix} \text{PH} & \text{<ge>} \\ \text{PC} & -1 \end{bmatrix}, \begin{bmatrix} \text{PC} & 1 \end{bmatrix} \right\}
\end{align*}
\]
Multiple inheritance

- Systematic co-variation is captured by multiple inheritance

\[
\begin{align*}
\text{MS} & \left\{ \begin{array}{c} \text{TMA} \ ppp \end{array} \right\} \\
\text{MPH} & \left\langle ..., \begin{array}{c} \text{PC} \ 1 \end{array} \right\rangle
\end{align*}
\]

\[
\begin{align*}
\text{PREF} & \left\langle \left[ \begin{array}{c}
\text{PH} <ge> \\
\text{PC} -1
\end{array} \right], \left[ \begin{array}{c}
\text{PH} <t> \\
\text{PC} -1
\end{array} \right] \right\rangle \\
\text{SUFF} & \left\langle \left[ \begin{array}{c}
\text{PH} <en> \\
\text{PC} -1
\end{array} \right], \left[ \begin{array}{c}
\text{PH} <t> \\
\text{PC} -1
\end{array} \right] \right\rangle \\
\text{MPH} & \left\langle \left[ \begin{array}{c}
\text{PH} <ge> \\
\text{PC} -1
\end{array} \right], \begin{array}{c}
\text{PH} <en> \\
\text{PC} -1
\end{array} \right\rangle
\end{align*}
\]

(e.g. gesetzt) (e.g. geschrieben) (e.g. übersetzt) (e.g. überschrieben)
Capturing word-level generalizations about exponence

Applications
Parallel exponence

- In some systems, the shape and position of affixes have separate exponential value.
- Swahili person markers (Stump, 1993)
  - Position encodes grammatical function
  - Shape encodes person/number/gender

(1)  

a. **ni-ta-wa-penda**  
   1SG-FUT-3PL-like  
   ‘I will like them.’

b. **wa-ta-ni-penda**  
   3PL-FUT-1SG-like  
   ‘They will like me.’
Hierarchies of rules

- Easily modeled in IbM by having separate POSITION and SHAPE dimensions describing different aspects of the same morph

```
rule-exp

SHAPE

[ MS { [ PER 1 ] [ NUM sg ] } ]
[ MPH { [ PH <ni> ] } ]

[ MS { [ PER 3 ] [ NUM pl ] } ]
[ MPH { [ PH <wa> ] } ]

POSITION

[ MS { [ subj ] } ]
[ MPH { [ PC -3 ] } ]

[ MS { [ obj ] } ]
[ MPH { [ PC -1 ] } ]
```

```
Hierarchies of rules

- Shapes that are specific to one position are rigidly attached in both dimensions.
Gestalt exponence

▶ Some systems exhibit constructional or Gestalt exponence (Blevins, 2016).

▶ Estonian first declension nouns:

<table>
<thead>
<tr>
<th></th>
<th>SG</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOM</td>
<td>nokk</td>
<td>nok-a-d</td>
</tr>
<tr>
<td>GEN</td>
<td>nok-a</td>
<td>nokk-a-de</td>
</tr>
<tr>
<td>PART</td>
<td>nokk-a</td>
<td>nokk-a-sid</td>
</tr>
</tbody>
</table>

▶ We want to capture holistic properties of individual words, e.g.

▶ No morph in the PART.SG is specific to the PART.
▶ NOM.PL contains the same morphs found in the GEN.SG, while GEN.PL contains the same morphs found in PART.SG

▶ While still capturing generalizations over the paradigm, e.g.

▶ Plural uses case suffixes
▶ Default character of theme vowel
▶ Default character or strong stem
Generalizations over combinations of exponents

- Three dimensions controlling:
  - **STEM**: the choice of a stem alternant
  - **THEME**: the possible introduction of a theme vowel
  - **SFX**: the possible introduction of a case-number suffix

![Diagram showing realisation rules]

- **realisation-rule**
- **STEM**
  - **st-rule**
    - **wk-st-rule**
    - **g-sg-wk-st-rule**
  - **grl-st-rule**
- **THEME**
  - **theme-rule**
    - **n-sg-rule**
      - **g-sg-rule**
      - **g-pl-rule**
    - **grl-sg-rule**
    - **g-pl-rule**
  - **sg-rule**
- **SFX**
  - **pl-rule**
    - **n-pl-rule**
    - **p-p-rule**
Generalizations over combinations of exponents

- Some rule types in the THEME and SFX dimensions jointly determine the how many morphs are used:
Generalizations over combinations of exponents

In the NOM.SG, a special rule type belonging to both the THEME and SUFFIX dimension ensures that no theme vowel is used. The stem is the default, strong stem.
Generalizations over combinations of exponents

- In the GEN.SG, a special stem introduction rule type kicks in, making sure a weak stem is used. The other three relevant types ensure that exactly two morphs are used and introduce the theme vowel.
Generalizations over combinations of exponents

- The PART.SG is licensed just like the GEN.SG except that the default, strong stem is selected.
Generalizations over combinations of exponents

- Plural forms rely on a rule type requiring three morphs, and vary in the choice of stem allomorph and suffix.
IbM as constructional morphology

- IbM implements basic tenets of construction grammar in the context of inflection (see also Koenig 1994; Gurevich 2006; Booij 2010):
  - Rules of exponence may be constructional, in the sense that combinations of units of form (constructions) may contribute content unpredictable from the joint contributions of the individual units.
  - Through hierarchical organization, rules of exponence may capture generalizations about form-content relationships at any level of granularity.
Capturing lexeme-level generalizations about exponence
Paradigm identifiers I

- In IbM, every bit of form has to be licensed by some rule of exponence.
- Hence IbM makes crucial use of rules of stem introduction.
- We argue that these rules realize the paradigm identifier or PID (Bonami and Crysmann, 2018).
- The PID encapsulates all information that is specific to one paradigm:
  - Minimally, a stem shape.

The English lexeme book (partial lexical entry)

\[
\begin{array}{|c|c|}
\hline
\text{lexeme} & \text{noun} \\
\text{SS|CAT|HD} & \text{LID } \text{book-rel} \\
\text{PID} & \text{pid} \\
\text{} & \text{STEM } <\text{bok}> \\
\hline
\end{array}
\]

A basic rule of stem introduction

\[
\begin{align*}
\text{MS} & \left\{ \begin{array}{|c|}
\text{pid} \\
\text{STEM} \end{array} \right\} \\
\text{MPH} & \left\langle \begin{array}{|c|}
\text{PH} \end{array} \right\rangle
\end{align*}
\]
Where needed:
- Separate stem and thematic elements (Bonami and Lacroix, 2011; Crysmann and Bonami, 2017)
- Stem space (Bonami and Boyé, 2002) encoded as an ordered list of stems (Bonami and Boyé, 2006)
- Grammatical gender

PID types are organized in an inheritance hierarchy.
- PID types implement irreducible inflection class distinctions
- Allows for highly structured encoding of inflection class systems.

We illustrate this by looking at Czech declension (Bonami and Crysmann, 2018).
**Czech declension: basic facts**

- Partial paradigms of main declension types for masculine inanimate and neuter nouns:

<table>
<thead>
<tr>
<th></th>
<th><strong>MASCULINE</strong></th>
<th></th>
<th><strong>NEUTER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hard</td>
<td>soft</td>
<td>hard</td>
</tr>
<tr>
<td><strong>SG</strong></td>
<td><strong>NOM</strong></td>
<td>most</td>
<td>pokoj</td>
</tr>
<tr>
<td></td>
<td><strong>GEN</strong></td>
<td>most-u</td>
<td>pokoj-e</td>
</tr>
<tr>
<td></td>
<td><strong>DAT</strong></td>
<td>most-u</td>
<td>pokoj-i</td>
</tr>
<tr>
<td></td>
<td><strong>ACC</strong></td>
<td>most</td>
<td>pokoj</td>
</tr>
<tr>
<td><strong>PL</strong></td>
<td><strong>NOM</strong></td>
<td>most-y</td>
<td>pokoj-e</td>
</tr>
<tr>
<td></td>
<td><strong>GEN</strong></td>
<td>most-ů</td>
<td>pokoj-ů</td>
</tr>
<tr>
<td></td>
<td><strong>DAT</strong></td>
<td>most-ům</td>
<td>pokoj-ům</td>
</tr>
<tr>
<td></td>
<td><strong>ACC</strong></td>
<td>most-y</td>
<td>pokoj-e</td>
</tr>
<tr>
<td></td>
<td>‘bridge’</td>
<td>‘room’</td>
<td>‘town’</td>
</tr>
</tbody>
</table>

- Existence of generalizations based on **gender** or **hard vs. soft declension type**.
- Hard vs. soft only partially predictable from the quality of the stem-final consonant.
Cross-classifying lexemes I

- Hard vs. soft as a distinction of type of PID value.

- Individual lexemes pick a specific gender and PID type
Cross-classifying lexemes II

- Particular rules of exponence may select underspecified PID values

![Diagram of cross-classifying lexemes II]

- **rln-rule**
  - **gs-rule**
    - **MS**
      - [CASE, gen]
    - **num sg**
  - **mph**
    - **hard-pid gen mas**
    - **ph ⟨/u/⟩**
    - (e.g. most-u)

  - **mph**
    - **hard-pid gen neu**
    - **ph ⟨/a/⟩**
    - (e.g. měst-á)

  - **mph**
    - **soft-pid,...**
    - **ph ⟨/e/⟩**
    - (e.g. pokoj-é, moř-e)
Hybrid classes

- This corner of the Czech declension system exhibits two types of hybridization between hard and soft declensions.
  - Lexically-conditioned overabundance in the masculine
  - Heteroclisis in the neuter

<table>
<thead>
<tr>
<th></th>
<th>hard</th>
<th>MASCULINE hybrid</th>
<th>soft</th>
<th>hard</th>
<th>NEUTER hybrid</th>
<th>soft</th>
</tr>
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<tbody>
<tr>
<td><strong>SG</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOM</td>
<td>most</td>
<td>pramen</td>
<td>pokoj</td>
<td>měst-o</td>
<td>kuř-e</td>
<td>moř-e</td>
</tr>
<tr>
<td>GEN</td>
<td>most-u</td>
<td>pramen-u~pramen-e</td>
<td>pokoj-e</td>
<td>měst-a</td>
<td>kuř-et-e</td>
<td>moř-e</td>
</tr>
<tr>
<td>DAT</td>
<td>most-u</td>
<td>pramen-u~pramen-i</td>
<td>pokoj-i</td>
<td>měst-u</td>
<td>kuř-et-i</td>
<td>moř-i</td>
</tr>
<tr>
<td>ACC</td>
<td>most</td>
<td>pramen</td>
<td>pokoj</td>
<td>měst-o</td>
<td>kuř-e</td>
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<tr>
<td><strong>PL</strong></td>
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<td></td>
</tr>
<tr>
<td>NOM</td>
<td>most-y</td>
<td>pramen-y</td>
<td>pokoj-e</td>
<td>měst-a</td>
<td>kuř-at-a</td>
<td>moř-e</td>
</tr>
<tr>
<td>GEN</td>
<td>most-ů</td>
<td>pramen-ů</td>
<td>pokoj-ů</td>
<td>měst</td>
<td>kuř-at</td>
<td>moř-í</td>
</tr>
<tr>
<td>DAT</td>
<td>most-ům</td>
<td>pramen-ům</td>
<td>pokoj-ům</td>
<td>měst-ům</td>
<td>kuř-at-ům</td>
<td>moř-ím</td>
</tr>
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<td>pramen-y</td>
<td>pokoj-e</td>
<td>měst-a</td>
<td>kuř-at-a</td>
<td>moř-e</td>
</tr>
</tbody>
</table>

| ‘bridge’ | ‘spring’ | ‘room’ | ‘town’ | ‘chicken’ | ‘sea’ |
Hybrid classes in the PID hierarchy

- Hybrid classes have multiple supertypes in the PID hierarchy:

```
pid
  hard-pid
  strict-hard-pid
  hybrid-pid
  strict-soft-pid

  soft-pid
```

- Both overabundant and heteroclite lexemes belong the the mixed-pid type.
- Rules of exponence may pick out a leaf type or a supertype.
Overabundance and the PID hierarchy

- Overabundance occurs where two rules expressing the same features pick out distinct supertypes of a lexeme’s PID.

- Heteroclisis occurs where the PID type is mixed, but no pair of rules expressing the same features pick out different supertypes.
Supporting evidence: inductive classification

- Beniamine (forthcoming) infers hierarchies of classes from raw inflectional data.
- Densely populated class lattices, with a high prevalence of hybrid classes.
Guzman Naranjo (2019):
- In general, phonological similarity of stems predicts similarity of inflectional behavior.
  - Naturally captured in IbM as constraints on PID.
- In overabundant hybridization, the stems of hybrid classes have phonological properties intermediate between those of the two non-overabundant classes.
  - Predicted by the present analysis of hybridization.
  - Although Guzman Naranjo does not discuss it, we predict that the same will hold for heteroclite hybridization.
Outlook: questioning presuppositions
At the beginning of the talk I made explicit three presuppositions:

- I assume a pre-established segmentation of words into stems and affixes.
- I assume that stem alternants as well as affixes may have exponential value.
- I assume a pre-established statement of the exponential value of each element.

These presuppositions would be unproblematic if we had well-established, undisputed ways of meeting these assumptions.

But we don’t (Spencer, 2012).
Questioning presuppositions: allomorphy

- Consider the following patterns of stem alternation in French:

<table>
<thead>
<tr>
<th></th>
<th>1SG</th>
<th>2SG</th>
<th>3SG</th>
<th>1PL</th>
<th>2PL</th>
<th>3PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>démener</td>
<td>démɛn</td>
<td>démɛn</td>
<td>démɛn</td>
<td>démɛn</td>
<td>démɛn</td>
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<td>décéder</td>
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<td>déjeuner</td>
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<td>dejœn</td>
<td>dejœn</td>
<td>dejœn</td>
<td>dejœn</td>
</tr>
</tbody>
</table>

- Analytic customs suggest to not treat alternating vowels as exponents, because they are not taken to be distinct morphs.

- Yet these alternating vowels, rather than the global shape of the stems, have exponential value, in the sense that they constitute a phonological property of the word with contrastive value.

- In general then, we need to consider how each (sub)segmental property of a word contributes to exponence.

- Beniamine and Bonami (2019): steps towards an automated, inductive segmentation strategy grounded in the contrastive value of individual phonological properties of words.
Questioning presuppositions: exponents of what?

- Consider the distribution of -ő in French conjugation.

<table>
<thead>
<tr>
<th></th>
<th>1SG</th>
<th>2SG</th>
<th>3SG</th>
<th>1PL</th>
<th>2PL</th>
<th>3PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRS</td>
<td>lav</td>
<td>lav</td>
<td>lav</td>
<td>lav</td>
<td>lave</td>
<td>lav</td>
</tr>
<tr>
<td>PST.IPVF</td>
<td>lave</td>
<td>lave</td>
<td>lave</td>
<td>lavjő</td>
<td>lavje</td>
<td>lave</td>
</tr>
<tr>
<td>PST.PFV</td>
<td>lave</td>
<td>lava</td>
<td>lava</td>
<td>lavam</td>
<td>lavat</td>
<td>laveβ</td>
</tr>
<tr>
<td>FUT</td>
<td>lavenɛ</td>
<td>lavenɛ</td>
<td>lavenɛ</td>
<td>lavenɛ</td>
<td>lavenɛ</td>
<td>lavenɛ</td>
</tr>
</tbody>
</table>

- ũ has a quirky distribution: (1PL ∧ ¬PST.PFV) ∨ (3PL ∧ FUT)

- Our analytic habit is to try as much as possible to reduce such distributions by appealing to homonymy and Panini’s Principle
  - -ů₁: 1PL, -m: IND.PST.PFV.1PL, -ů₂: FUT.3PL

- This is definitely worth questioning: Saying that -ű is the exponent of 1PL does not do full justice to the information that is provided to the speaker by the fact that the word ends in -ű.

- Way forward: exponence as probability of content given form.
Questioning presuppositions: exponence types

- Theories of exponence are still largely based on Matthews’s 1972 typology of distributions.
- Yet this is far from complete (Harris, 2017).
- In particular, basic definitions do not exhaust the types that present themselves (Carroll, 2019).

<table>
<thead>
<tr>
<th></th>
<th>SG</th>
<th>PL</th>
<th></th>
<th>SG</th>
<th>PL</th>
<th></th>
<th>SG</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x</td>
<td></td>
<td>1</td>
<td>x</td>
<td></td>
<td>1</td>
<td>x</td>
<td>x</td>
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<td>2</td>
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<td>x</td>
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<td></td>
<td>x</td>
<td>2</td>
<td></td>
<td>x</td>
</tr>
<tr>
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<td>x</td>
<td>xy</td>
<td>3</td>
<td>xy</td>
<td></td>
<td>3</td>
<td>xy</td>
<td>y</td>
</tr>
</tbody>
</table>

Simple exponence

Multiple exponence

Way forward (current collaboration with Matthew Carroll):

- Explicit model-theoretic formalization of distribution types
- Large-scale empirical exploration of the prevalence of different types
Conclusions

- I have presented a general formal framework for inflectional morphology that crucially uses:
  - Many-to-many rules of exponence
  - Inheritance hierarchies of rules of exponence
  - Inheritance hierarchies of paradigm types
- I have highlighted how this provides for direct expression of various types of generalizations over exponence:
  - Variable morphotactics
  - Parallel exponence
  - Gestalt exponence
  - Hybrid exponence strategies, in the form of both overabundance and heteroclisis
- Much conceptual and empirical work remains to be done on the nature and typology of exponence.
- IbM provides a rich formal scaffolding to build on.
References


References III


Why morphousness is not a problem

▶ Classical arguments against morphousness (Anderson, 1992) do not apply to IbM:
  ▶ No ‘zero morphemes’: absence of expression is the absence of a morph, not the presence of an empty element.
  ▶ The constraint-based lexicalist architecture is sufficient to ensure that syntax cannot manipulate morphs.
  ▶ Because IbM is declarative, rules do not feed other rules, and hence there is no sense in which one rule could be sensitive to the structure build by another.
  ▶ Non-concatenative morphology is not an obstacle to morphousness within a model-theoretic model, and can be addressed by combining underspecified descriptions of the same string.

Lexical entry of RING:

\[
\begin{array}{l}
\text{apo-vb-pid} \\
\text{STEM} \quad <r>+<\text{vowel}>+<\text{ng}>
\end{array}
\]

Exponence of past:

\[
\begin{array}{l}
\text{MS} \quad \left\{ \begin{array}{l}
\text{apo-vb-pid} \\
\text{STEM} \quad 1 \\
\text{TMA} \quad \text{pst}
\end{array} \right. \\
\text{MPH} \quad \left\{ \begin{array}{l}
\text{PH} \quad 1 \\
\text{list(seg)}+<\text{a}>+\text{list(cons)}
\end{array} \right.
\end{array}
\]