

Morphological gradience in phonology

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30th Manchester Phonology Meeting (25-27 May 2023)

Aim

Study two left-edge processes in English stress-shifted derivatives that have been attributed to identity with the local base

To test if including other bases from a derivative's morphological family can provide a better account than just including the local base

The phonology of morphologically complex words

In English, most affixed words can be seen as parts of two main paradigms

Morphological category

All forms that contain the same affix

⋮

austerity

conjugality

Uniformity of phonological behaviour associated to:

Idiosyncratic properties of affixes (neutral, stress-shifting, cohering, etc.)

... *connect* *connective*

connectivity

connector *connection* ...

Morphological family

All forms that contain the same root

gratuity

periodicity

⋮

Dependencies between words (cyclicity, OO correspondence constraints, etc.)

Paradigmatic dependencies

This talk focuses on relations of phonological identity among members of the same **morphological family**

The phonological patterns of morphologically complex words sometimes differ from those of simplex words

Those differences can sometimes be predicted based on the phonological form of morphosyntactically related expressions, called **bases** ('paradigmatic dependence', [Bermúdez-Otero 2018](#))

There are two main controversies regarding the choice of bases: **containment** and **locality**

Containment

Embedded bases

... *connect* *connective* *connectivity*

Cyclic models (e.g. Stratal Phonology, Phase Theory) assume those are the only possible bases

Co-derivatives

connector *connection* ...

Theories based on correspondence between surface forms such as Lexical Conservatism assume that all members of the morphological family are potential bases

The latter have mainly been argued to be more adapted in cases in which complex words differ from the local base

remédiable
párodiable

rémedy
párody

remédial
**paródial*

(Steriade 1999, but see Bermúdez-Otero 2018 for a stratal-cyclic analysis)

Locality

Embedded bases

Non-embedded bases

... *connect* *connective* *connectivity* *connector* *connection* ...

If one opts for containment only, should the base be **local** (= the closest form)?

- There are reports of dependencies that rely on more deeply embedded bases

Phonological property different from that of the local base

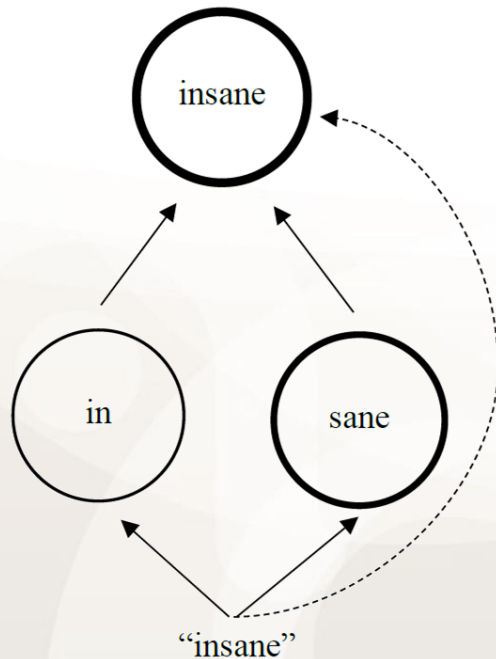
cycle [aɪ] *cyclic* [ɪ] *cyclicity* [aɪ] (Bermúdez-Otero 2007)

The more deeply embedded base is more frequent than the local base and is a better predictor of the preservation of a property that both bases share

connéct *connéctive* *connéctivité* (Dabouis 2019)

Segmentability

Many studies on morphophonetic or morphophonological variation have explored Hay's (2001, 2003) hypothesis that complex words may be accessed in the mental lexicon directly or via their constituents (=embedded base and affix)



-----> Direct route

——> Decomposed route

The route that is adopted depends mainly on the relative frequency of the base and the derivative and on the transparency of their semantic relationship

Segmentability

When exploring that hypothesis on stress preservation, [Collie \(2007, 2008\)](#) and [Dabouis \(2019\)](#) implement this in Stratal OT by having in the input either:

- The word itself (direct route)
- The base (decomposed route)

In [Dabouis \(2019\)](#), more deeply embedded bases are taken into account: if they are more frequent than the local base, they are considered to be the relevant base

Faithfulness constraints then interact with markedness constraints

Should there be only one base?

Whenever those approaches assume that there are several possible bases, the issue usually is **which one** should be used (but see [Breiss 2021](#) for an analysis where two bases are used)

- Selection based on **frequency** ([Collie 2008](#); [Dabouis 2019](#))
- Selection based on **markedness** ([Steriade & Stanton 2020](#))

All of those options end up importing **gradient structure** into the phonology **categorically** (= which base is used)

Some frameworks assume that **multiple words** that are related to a given derivative may be used to perform computation (e.g. [Kuperman et al. 2007](#), and notably analogy-based frameworks; see e.g. [Ardnt-Lappe 2015](#))

Should there be only one base?

Could it be that effects of frequency on paradigmatic dependencies and attributed to segmentability actually extend to the broader morphological family?



Let us assume that the strength of the relationship between the derivative and the other members of its morphological family is a function of their frequency

A hypothesis

This would predict different likelihoods for a derivative to have a phonological property \mathcal{P} :

Morphological family

- homogeneous with regards to phonological property \mathcal{P}
- highly frequent relative to the derivative



Higher

- heterogeneous with regards to phonological property \mathcal{P}
- less frequent than the derivative



Lower

Likelihood of derivative to have \mathcal{P}

Research question

Are processes of phonological identity between morphosyntactically related forms better captured using:

- The frequency of **embedded bases alone**, and if so is it better to use
 - the frequency of the **local base** alone?
 - the cumulated frequencies of **all embedded bases** that share \mathcal{P} ?
- The cumulated frequencies of all the forms in the **morphological family** that share \mathcal{P} ?
 - The potential contradictory effect of forms that do **not** share \mathcal{P} is left to future research

Phonological processes investigated

I will explore those questions on two processes that have been attributed to identity with embedded bases in stress-shifted derivatives, and will focus on British English:

➤ **Stress pattern /021(-)/**

depártnent

depàrtméntal

vs.

dictátor

dìctatórial

➤ **Vowel reduction, initial and intertonic positions**

cl[áɪ]mate

cl[aɪ]mátic

cond[é]nse

cònd[ɛ ~ ə]nsátion

vs.

f[á]mily

f[ə]míal

prep[é:]re

prèp[ə]rátion

Morphological families

Words sharing the same roots with identical or related semantics as those of the affixed words under investigation were identified as possible bases if the relevant syllable is stressed in those words

At this stage, the only bases that were included are:

➤ embedded bases:

e.g. *conductivity - conductive, conduct*

➤ co-derivatives, with the same root but (a) different suffix(es)

e.g. *conductance, conduction, conductor, conductress*

Morphological families

I did not include bases which:

- Themselves contain the derivative under scrutiny
e.g. *gesticulation* for *gesticulate*
- Are prefixed forms which share the same base
e.g. *unfounded* for *foundation*

Data

	/O21(-)/	Reduction: initial pretonic	Reduction: intertonic
Taken from	Dabouis (2019)	Dabouis & Fournier (in preparation)	
Source of data	Wells (2008)	Jones (2006)	Wells (2008)
Number of entries	274	569	184
Frequencies taken from	Subtlex-UK (van Heuven et al. 2014)		
Other variables affecting the process	<ul style="list-style-type: none"> • Closedness of syll1 • Closedness of syll2 	<ul style="list-style-type: none"> • Closedness of syllable • Syllable is an opaque prefix • Vowel length in base • Vowel is [+back] 	<ul style="list-style-type: none"> • Closedness of syllable

Vowels spelled with two letters (e.g. <oo>, <ea>) are excluded as this was found to be a possible bias

Frequency tests

Different models are tested for each process

- Absolute frequencies or relative frequency
- For absolute frequency, using only one frequency or both derivative and base frequency
- Local base frequency or cumulated base frequencies (all embedded or whole morphological family)

All frequencies are log-transformed (as \log_e)

- Cumulated frequencies are log-transformed after adding up all relevant base frequencies
- Relative frequencies are calculated as a ratio of log-transformed frequencies

Model comparisons

The different frequency measures were tested in different regression models along with the other significant predictors

Indicators for comparison

- Whether or not the base frequency is statistically significant
- If it is significant, whether or not the AIC is lower
 - A model is considered better than another model if its AIC is at least 2 points lower

Results

		/021(-)/ pattern	Vowel reduction: Intertonic	Vowel reduction: Initial pretonic
One frequency variable	Derivative	✓	✓	✓
	Local base	×	×	✓*
	All embedded bases	×	×	✓*
	All morph. family	✓	×	✓*
Base and derivative frequency	Local base	×	×	×
	All embedded bases	✓	✓	×
	All morph. family	✓	✓	×
Relative frequency	Local base	✓	✓	✓
	All embedded bases	✓	✓	✓
	All morph. family	✓	✓	✓

✓ Significant effect ($p < 0.05$)

✓* Significant effect in unexpected direction

× No significant effect ($p > 0.05$)

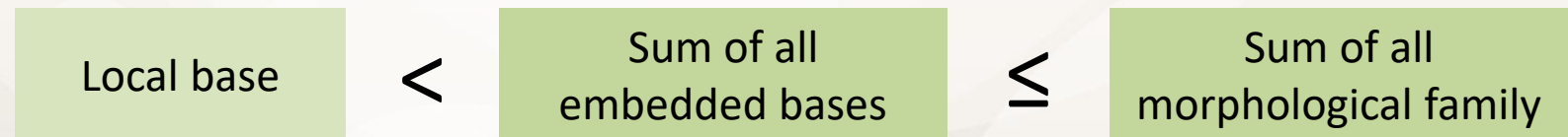
Best model(s) for a given process

Discussion

Relative frequency significant predictor for all three processes

- not better than derivative frequency for initial pretonic vowel reduction

Base frequencies:



→ It seems always better to go beyond the local base

Discussion

Acoustic reduction is generally found to occur in highly frequent forms (Fidelholtz 1975; Bell et al. 2009; Clopper & Turnbull 2018) but there are counterexamples (e.g. Kuperman et al. 2007)

While base and derivative frequencies are often associated to reduction in English affixes, lower relative frequency (= a more frequent base relative to the derivative) is usually associated with less reduction (Stein & Plag 2020)

Discussion

We do find an effect in that direction for base frequency:

- vowel reduction in initial pretonic position: reduction more likely if the base is more frequent

Difficult to make sense of that result considering that the relevant vowel is stressed in the base(s)

s[á]tire (514)

s[á]tirist (121)

s[à]tirization (0)

s[á]tirize (0)

but *s[ə]tirical* (305)?

Possible extensions: further questions

Study how heterogeneous morphological families behave:

e.g. is second-syllable stress support from *refer*, *referral* weakened by the existence of *reference*, *referent*, *referential* with first-syllable stress?

Are formatives that are smaller than the word also subject to frequency effects? If so, how do they interact with word frequencies?

e.g. [Hammond \(2003\)](#) assumes that Latinate prefixes like *con-* generally undergo vowel reduction because they are quite frequent

Possible extensions: further questions

How should we incorporate the frequency of words that contain the words we seek to study (e.g. role of the frequency of *fallaciously* to study *fallacious*)?

How do the processes investigated here behave with more gradient data like oral data?

Possible extensions: formalism

There are proposals in Gradient Harmonic Grammar (Smolensky & Goldrick 2016) that assume that representations can be gradient, with different levels of “activity”

However, it is often unclear where activity comes from

If gradient morphological effects of the kind discussed in this paper are confirmed on a broader scale empirically, we could explore the idea that all the members of the morphological family of a derivative are present in its input, and that their activity level is indexed to its frequency

Possible extensions: formalism

Example: MaxEnt tableau for *collectivity*

Input:	*CLASH	ID-STRESS	STRESS(VC)	STRESS-L	\mathcal{H}	p(grammar)
còllectívíty (2.6)						
colléctive (7.3)	5	0,8	3	1		
colléct (9.5)						
021	-5	-2.1		-1	-8.1	0,58
201		-5.4	-3		-8.4	0,42

The details of the analysis still need to be explored:

- different weighing of bases? (Breiss 2021 assigns a bigger weight to the local base than to other bases)
- Inclusion of a stored representation of the word itself in the input?

Conclusion

The results are not fully consistent, but they suggest that we may need to go beyond the local base to study paradigmatic dependencies

This lack of consistency of frequency effects is actually consistent with the literature: they do not always show up, and it is not clear why they do and when they do not

There is still a lot of work to do with other types of data and a more extensive use of derivational families (notably taking variability into account)

Thank you for your attention!

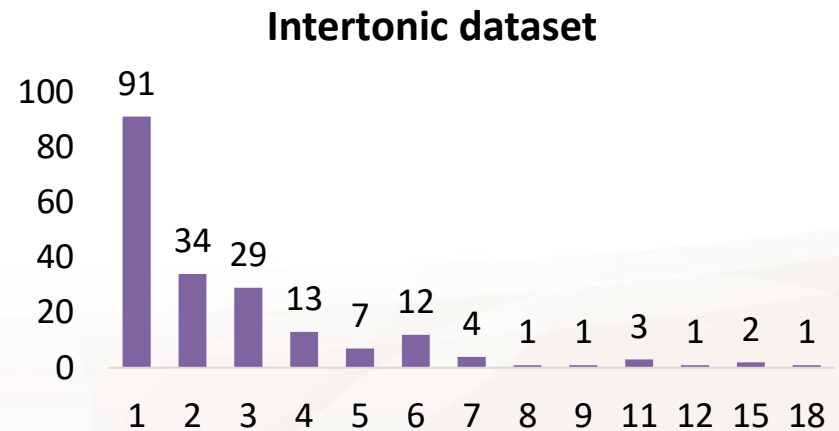
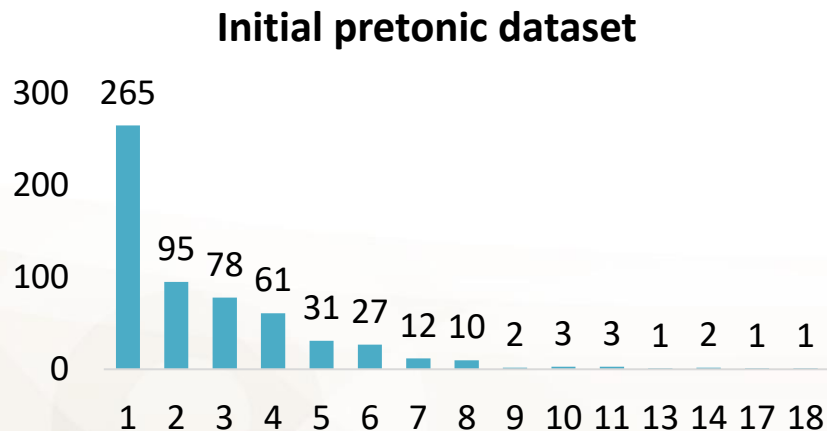
This work was supported by a DFG/ANR grant for the ERSaF project (“English Root Stress across Frameworks”, Clermont-Ferrand & Trier, November 2022 - present), ANR-21-FRAL-0001-01.

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Number of forms in paradigms

For the two reduction inventories: we get a Zipfian distribution
→ close to half of derivatives only have one base in the paradigm
(the local base)



This could explain why approaches in which only the local base is considered are quite successful: quite often, it is the only one available

Exceptional accent preservation

Model comparison: Absolute frequency

		Base frequency effect	AIC
One frequency variable	Derivative	Yes	159.2
	Local base	No	-
	Both bases	No	-
	Paradigm	Yes	159.9
Base & derivative frequencies as separate variables	Local base	No	-
	Both bases	Yes	164.6
	Paradigm	Yes	151.8

Exceptional accent preservation

Model comparison: relative frequency

		Base frequency effect	AIC
Relative frequency	Local base	Yes	158.0
	Both bases	Yes	152.7
	Paradigm	Yes	152.1
Relative Frequency + Derivative frequency	Local base	No (der fq NS)	-
	Both bases	Weak (der fq NS)	152.6
	Paradigm	Weak (der fq NS)	151.3

Intertonic vowel reduction

Model comparison: Absolute frequency

		Base frequency effect	AIC
	Derivative	-	392.5
One frequency variable	Local base	No	-
	Both bases	No	-
	Paradigm	No	-
Base & derivative frequencies as separate variables	Local base	No	-
	Both bases	Yes	389.4
	Paradigm	Yes	388.9

Intertonic vowel reduction

Model comparison: relative frequency

		Base frequency effect	AIC
Relative frequency	Local base	Yes	414.5
	Both bases	Yes	410.5
	Paradigm	Yes	411.1
Relative Frequency + Derivative frequency	Local base	No	-
	Both bases	No	-
	Paradigm	No	-

Initial pretonic vowel reduction

Model comparison: Absolute frequency

		Base frequency effect	AIC
One frequency variable	Derivative	-	1183.9
	Local base	Yes	1199.2
	Embedded bases	Yes	1203.2
	Paradigm	Yes	1204.33
Base & derivative frequencies as separate variables	Local base	No	-
	Both bases	No	-
	Paradigm	No	-

Initial pretonic vowel reduction

Model comparison: relative frequency

		Base frequency effect	AIC
Relative frequency	Local base	Yes	1199.86
	Both bases	Yes	1198.214
	Paradigm	Yes	1198.1
RF + der fq	Local base	No	-
	Both bases	No	-
	Paradigm	No	-