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Hungarian Emerging[1]

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ABSTRACT: Phonological theories tend to focus on the end point of learning, the adult grammar, assuming some innate linguistic component determines the nature of the grammar that is acquired. In Emergent phonology, we explore the hypothesis that adult grammars take the shapes they have because they can be acquired; we go further and propose that there is no innate linguistic component for phonological acquisition. Given these hypotheses, grammars are acquired piecemeal and learners rapidly generalise over subparts of the lexicon. One prediction is that we expect languages to have regularities with widely differing effect – both general patterns and subpatterns that exist but only in a narrow domain. We test this hypothesis against Hungarian vowel harmony, a harmony pattern that is often described as involving both [back] harmony and [round] harmony, despite the fact that the language has nonharmonic suffixes, suffixes with limited harmony, disharmony, antiharmony, and both transparency and opacity. In particular, we discuss patterns of suffix alternation involving harmony. The patterns, morphologically determined, range from no alternation, to alternating only along the front-back dimension, to alternating in terms of both backness and rounding, to alternating in terms of backness, rounding and height.

KEYWORDS: Hungarian; vowel harmony; Emergent Grammar; lexical representations; transparency; lexical specificity.

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1. Introduction

In this contribution, we contrast two views of how the lexicon interacts with phonotactics. We use Hungarian vowel harmony as a case study. The issue in question concerns how to account for phonological variation in the expression of grammatical units. In a structuralist/generative view, a single phonological representation (the "underlying representation") is posited for each lexeme. In the following schematic representations, lexemes are indicated by α, β, γ; phonological representations (underlying and surface) are indicated by X, Y, Z.

(1) Underlying representations

	a.	b.	c.
lexical representations	/X/$_{\alpha}$	/X/$_{\beta}$	/X/$_{\gamma}$
phonological expression	[X]	[X] [Y]	[X] [Y]…[Z]

The leading idea is that phonological variation is due to phonotactic modification of the underlying representation, a postulated start state. The details of how the modifications are encoded vary, e.g. whether they are expressed as rules or as constraints. The key point is that abstract morphemes contain a single specification for a start state with variation from that start state derived by a set of phonotactics.

A contrasting view is more surface-oriented. Rather than postulate some abstract singleton form from which all surface forms are derived, lexical entries are hypothesised to catalogue phonological expressions, where a particular lexeme may have one or more phonological expressions.

(2) Emergent representations

	a.	b.	c.
lexical representations	{X}$_{\alpha}$	{X, Y}$_{\beta}$	{X, Y, ..., Z}$_{\gamma}$
phonological expression	[X]	[X] [Y]	[X] [Y] ... [Z]

Under this view, the role of phonotactics is twofold. First, phonotactics may define well-formed members of a lexical set. Second, phonotactics play a crucial role in choosing between the members of a lexical set. In this exploration of vowel harmony patterns in Hungarian, we focus on the second role, expressing the core motivator of harmony by sequential *XY phonotactic conditions where X and Y are both phonological; we go on to motivate additional *XY conditions where one or both of X and Y are morphological classes, a logical extension of a model allowing X and Y to range over both phonological and morphological categories.

2. Emergent phonology

Our analysis is constructed within Emergent phonology (see Mohanan *et al.* 2010; Archangeli & Pulleyblank 2016, 2018, and especially Archangeli & Pulleyblank 2022). Here, we highlight two elements of that model which figure prominently in our exploration of Hungarian, the *morph set* and the *learned wellformedness condition*.

At its heart, Emergent phonology assumes much if not all of a phonological system is acquired without appeal to a genetic endowment specific to language. Rather, the learner makes use of normal human cognition (memory, similarity, frequency, categorisation, generalisation, etc.). Elements of an analysis for a specific language are learned based on exposure. Generalisations emerge from fragmentary exposure to data – and are modified during early learning. Learners generalise rapidly, using data fragments, hypothesising generalisations that may or may not extend in exceptionless fashion to the whole language. Generalisations are strengthened by repetition; unsupported generalisations atrophy.

Learners generalise about the sounds being heard, identifying high-frequency similar tokens that ultimately generalise into segments, identifying similar high-frequency properties of segments that generalise into features and type conditions, *X, preferring combinations of features common in the language, and identifying sequences with unexpectedly high frequency, to generalise into sequential conditions, *XY.

As a learner acquires words, repeated elements emerge as higher frequency similar tokens and get classed together, giving rise to sets of like items. Initially these sets may correspond largely to words or phrases in the adult language but as learning continues, subparts are identified as being similar either phonetically, semantically, or both – giving rise to morphs. The recognition that certain morphs share the same semantic and syntactic labels results in grouping such morphs together in *morph sets*; words are created by compiling members of morph sets appropriate to the desired meaning.

Morph sets and conditions come together when a word is compiled from morph sets with multiple members – the wellformedness conditions determine which of the compilations conforms best to language preferences.[2]

Note that the learner does not generalise on the basis of thousands of items and phrases encountered simultaneously, but rather on a data set that incrementally increases as items are learned. As such, a prediction is that generalisations will begin by being true of some subset of the morphology; in some cases, these lead to wellformedness conditions that are true of the entire language, while in many cases the conditions do not extend beyond a lexical subset. We consider here an aspect of Hungarian vowel harmony where this prediction holds true: none of the phonological wellformedness conditions involved with harmony are unambiguously true of the entire language. Although we suggest that the actual phonotactics responsible for harmony are very simple, we show that the effect of these phonotactics is limited by the morph sets being compiled, resulting in intricate patterns and sub-patterns of harmony. We treat a selection here.

In Hungarian, suffix vowels alternate depending on the root to which they are attached, exhibiting backness (palatal) harmony and rounding harmony (Vago 1976;

[2] This is a very brief sketch of only part of the model of Emergent phonology. Other critical elements address systematic relations between morphs within a morph set and the productivity of those relations. For Hungarian, the only productive generalisation relating to harmony in morph sets is that morph sets with a front rounded morph invariably also have a morph with a corresponding back vowel, a generalisation to be encoded via a morph set relation (between front round and back) and a morph set condition (ensuring productivity of the relation). See Archangeli & Pulleyblank (2022) for a complete introduction to morph set relations and morph set conditions.

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Siptár & Törkenczy 2000; Hayes & Londe 2006; Hayes *et al.* 2009; Törkenczy 2011; among numerous others). Such cases, where multiple morphemes within a word agree for the harmonic feature, are the hallmark of word-domain harmony. As we show, however, different morphemes alternate in interestingly different ways. Some morphemes exhibit no alternation at all, with a single morph being attested. Other morphemes exhibit two variants; still others exhibit three, and some exhibit four. We begin with a ternary morph set, exhibiting both backness and rounding harmony.

3. Backness and rounding harmony basics: ternary morph sets

We discuss two phonotactic pressures, one enforcing backness harmony and the other forcing rounding harmony. We begin with suffixes that have three forms, e.g. {hɛz, høz, hoz}$_{\text{ALLATIVE}}$ – front unrounded, front rounded and back (rounded). As seen in (3), within a word suffix backness corresponds to root backness, and, for front vowel suffix variants, roundness corresponds to root roundness. Rows are arranged by the height of the final vowel in the root; there are nine productive suffixes of this type in Hungarian (Törkenczy 2011).

(3) Hungarian: ALLATIVE suffix (adapted from Siptár & Törkenczy 2000: 72)

	[front nonround]		[front round]		[back]	
high	[viːs-hɛz] *víz-hez*	'water'	[tyːs-høz] *tűz-höz*	'fire'	[kosoruː-hoz] *koszorú-hoz*	'wreath'
mid	[køteːɲ-hɛz] *kötény-hez*	'apron'	[sɛmøltʃ-høz] *szemölcs-höz*	'wart'	[hɛrɲoː-hoz] *hernyó-hoz*	'caterpillar'
low	[koːdɛks-hɛz] *kódex-hez*	'codex'			[nyɔns-hoz] *nüansz-hoz*	'nuance'
					[gaːs-hoz] *gáz-hoz*	'gas'

To situate these alternations in the context of Hungarian vocalic possibilities, we present the inventory of vowels in (4) (Siptár & Törkenczy 2000). The three classifications correspond to the three suffixes in the allative – front unrounded, front rounded, and back.

(4) Hungarian vowel inventory

		[front]				[back]			
		front				*central*	*back*		
		[nonround]		[round]		[nonround]	[round]		
[high]		i	iː	y	yː		u	uː	
upper	[mid]		eː		øː			oː	
lower	[mid]			ø			o		
upper	[low]	ɛ					ɔ		
lower	[low]					aː			

The presentation of vowels in (4) includes two types of information. First, it provides a broad phonetic classification of the vowels, in italics. Second, it provides a phonological classification (indicated by square brackets) based on a combination of phonetics and phonological behaviour. Following Siptár and Törkenczy (2000), central and back phonetic vowels are phonologically grouped into a [back] class; upper and lower mid vowels are grouped into a single [mid] category, and upper and lower low vowels are grouped into a single [low] category. Vertical lines distinguish the three harmonic classes of (3): [front nonround], [front round], [back].

The core harmonic pattern illustrated in (3) is straightforwardly achieved. This class of suffixes has three surface forms: (i) front nonround, (ii) front round, (iii) back. Harmony wellformedness conditions govern the choice among these three forms. Paired syntagmatic and type conditions are required, one for the back-front dimension and one for the round-nonround dimension. A backness pair expresses a sequential condition preferring backness harmony (Hayes & Londe 2006), otherwise front vowels are preferred, expressed as a type condition; the pair is formalised in (5).

(5) Hungarian backness wellformedness conditions: *[bk] [fr] & *[bk]

*[back] [front] $\mathcal{F}$: vowels $\mathcal{D}$: word	Assessing vowels only, assign a violation to a form for each sequence of a back vowel followed by a front vowel.
*[back] $\mathcal{F}$: vowels $\mathcal{D}$: word	Assign a violation to a form for each back vowel.

A rounding pair expresses a sequential condition governing rounding, otherwise nonround vowels are preferred (again with a type condition); the pair is formalised in (6).[3] In conditions, Focus (F) identifies the phonological elements relevant for each wellformedness condition while Domain (D) calls out the relevant morphological unit.

(6) Hungarian roundness wellformedness conditions: *[rd] [nonrd] & *[rd]

*[round] [nonround] $\mathcal{F}$: vowels $\mathcal{D}$: morph, word	Assessing vowels only, assign a violation to a form for each sequence of a rounded vowel followed by an unrounded vowel.
*[round] $\mathcal{F}$: vowels $\mathcal{D}$: word	Assign a violation to a form for each rounded vowel.

With a front unrounded root, a front unrounded suffix is chosen simply to avoid back and rounded vowels: No further syntagmatic conditions are needed, illustrated

[3] In Archangeli & Pulleyblank (2022), we argue that type conditions (such as *[back] and *[round]) arise from generalising across the frequencies of the different morphs within a set. Where the less frequent morphs share a property (such as [back] vowels), the learner generalises a preference against backness, namely *[back]. While this is similar to the concept of "default" in theories of underspecification (cf. Archangeli 1988), the conceptualisation and effects are quite different.

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in (7).[4] (The ranking of back wellformedness above round wellformedness is addressed in section 4.2.)

(7) Assessment for [viːs-hɛz] ‘water-ALLATIVE’

morph sets: {viːz, viːs}$_{\text{WATER}}$; {hɛz, høz, hoz}$_{\text{ALLATIVE}}$

WATER-ALLATIVE	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
☞ a. viːs-hɛz				
b. viːs-høz				*!
c. viːs-hoz		*!		*

With a front rounded root, a front rounded suffix is chosen, avoiding both a back vowel and a rounded-unrounded sequence, (8).

(8) Assessment for [tøk-høz] ‘marrow-ALLATIVE’ (Törkenczy 2011: 2969)

morph sets: {tøk}$_{\text{MARROW}}$; {hɛz, høz, hoz}$_{\text{ALLATIVE}}$

MARROW-ALLATIVE	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
a. tøk-hɛz			*!	*
☞ b. tøk-høz				**
c. tøk-hoz		*!		**

With a back vowel root, a following back vowel is chosen, avoiding a back-front sequence, (9).

(9) Assessment for [gaːs-hoz] ‘gas-ALLATIVE’

morph sets: {gaːz, gaːs}$_{\text{GAS}}$; {hɛz, høz, hoz}$_{\text{ALLATIVE}}$

GAS-ALLATIVE	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
a. gaːs-hɛz	*!	*		
b. gaːs-høz	*!	*		*
☞ c. gaːs-hoz		**		*

These cases illustrate the core of Hungarian harmony. Roots include vowels specified according to the combinations of features seen in the inventory in (4). That is, roots contain invariant vowels that are either front nonround, front round, or back (both round and nonround). Suffixes of the type illustrated contain three variants,

[4] In the interest of completeness, we include two voicing options in morph sets where appropriate, such as {viːz, viːs}$_{\text{WATER}}$. We do not discuss this pattern and only use the correct choice in the compilations. Thanks to Péter Siptár for discussion.

one that is front nonround, one that is front round and one that is back. The conditions *[back] and *[round] result in a general preference for front nonround vowels. When roots are back and/or round, however, a form of the suffix is preferred that avoids a mismatch in backness and rounding.

4. Suffixes with limited harmony

Not all Hungarian suffixes have the ternary option, with exactly three morphs in the morph set. We turn now to cases where a suffix morph set has less than three members – either one morph or two.

4.1. Nonalternating suffixes: Morph sets with a single member

Some suffixes do not alternate. Siptár and Törkenczy (2000: 65-66) identify 24 suffixes with a single invariant form, illustrated in (10).[5] As noted in Siptár and Törkenczy (2000), these nonalternating suffixes are of two types: Either they contain a front unrounded vowel ('neutral' —under our analysis due to *[bk] and *[rd]) or they contain a back vowel— front rounded vowels do not appear in the nonalternating class.[6]

(10) Single-member morph sets

vowel	suffix	example	gloss	monovoc.	polyvoc.
[i]	{ig}	[hɔt-ig]	'up to six'	13	6+
[iː]	{iːt}	[tɔn-iːt]	'teach'	1	1+
[eː]	{eː}	[laːɲ-eː]	'belonging to a girl'	12	
[aː]	{aːl}	[rɛt͡sɛnz-aːl]	'review-VERB'	1+	2+
[ɔ]	{ɔ}	[il-ɔ]	'Helen-DIM'	1+	2+
[o]	{kor}	[øt-kor]	'at five'	2+	2+
[oː]	{koː}	[fɛr-koː]	'Frank-DIM'	1+	1+
[u]	{uʃ}	[t͡sit͡s-uʃ]	'kitten'	2+	2+

In the surface-oriented framework proposed here, the difference between an alternating suffix and a nonalternating suffix is transparently encoded in the morph set. While a suffix like the ALLATIVE has multiple morphs, {hɛz, høz, hoz}, the suffixes in (10) have only one morph each: {ig}, {kor}, {uʃ}, etc. When compiled with different roots, certain phonotactics may be violated by the resulting form; the absence

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[5] The numbers in the righthand columns indicate how many suffixes of each type have been identified, suffixes that are monovoc(alic) (e.g., *öt-kor* 'at five') and polyvoc(alic) (e.g., *defet-izmus* 'defeatism'). Where a number is followed by a '+', Siptár and Törkenczy note that there may be additional suffixes in that category, depending on the morphological analysis of certain elements. They consider their count for monovocalic [i], [iː], [eː] to be exhaustive, hence these are not followed by '+'. Note that only one non-alternating suffix with a back vowel is productive, namely *-kor* (see Törkenczy 2011: 2972).

[6] We attribute this redundancy to the effect of a Morph Structure Condition: a morph set is ill-formed if it contains a front rounded vowel and there is no corresponding morph with a back vowel. For reasons of space we do not discuss this further or formalise it here. See footnote 2 for brief discussion of Morph Set Relations and Morph Set Conditions.

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of any further suffix morphs that would resolve such violations ensures nonalternating —and, in some cases, disharmonic— surface forms. There is simply no other alternative, as is illustrated by the assessment in (11). As with Optimality Theory, the speaker simply uses the best available form, even when it does not perfectly match the phonotactics of the language.

(11) Assessment for [hɔt-ig] 'up to six'

morph sets: $\{$hɔt$\}_{\text{SIX}}$; $\{$ig$\}_{\text{UP TO}}$

	SIX-UP TO	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
☝	a. hɔt-ig	*	*	*	*

The simplicity of the Emergent analysis is in stark contrast to the problems that arise for analyses that posit underlying forms, deriving harmony by generating corresponding candidates (as in Optimality Theory (OT), Prince & Smolensky 1993) or altering the form (as with rules). Consider suffixes such as *-ig*, *-i:t*, and *-kor* in examples such as [hɔt-ig] 'up to six', [tɔn-iːt] 'teach' and [heːt-kor] 'at 7'. In such cases, we do not observe back harmony between the root and the suffix. While we might attribute this lack of harmony to the putative neutrality of front unrounded vowels with *-ig* and *-i:t*, this hypothesis is somewhat problematic. First, it does not account for cases with a back vowel in the suffix, like *-kor*, since [ø] is a wellformed Hungarian vowel. Second, in an OT framework, Gen would provide fully harmonic candidates for every non-alternating suffix; while such forms could be ruled out in some cases due to the following being 'absolutely' ill-formed (e.g., by *[ɯ]), in other cases Eval would prefer harmonic sequences to disharmonic sequences.[7]

Some distinction needs to be made between suffixes which exhibit multiple surface forms, as seen in (3), and suffixes that are invariant. Given the range of vowels in invariant forms, as seen in (10), a purely phonological characterisation of the invariant class is not possible. This is precisely the Emergent analysis: whether and how much alternation is found depends on the nature of a morph set, the lexical representation connecting sound and meaning. Morph sets with only one member cannot show alternations. Alternation is characterised by morph sets with multiple members.

4.2. Limited alternations: Morph sets with only two members

The problem for theories based on underlying representation is even more serious. In addition to the many invariant suffixes, several suffixes exhibit only two surface forms – not three as seen with the ALLATIVE marker in section 3. Like the invariant suffixes of (10), the binary suffixes show a range of vowel qualities, given in (12) (Törkenczy 2011: 2969-2970).

[7] Thanks to Péter Siptár for discussion.

All suffixes of this type exhibit a pair of morphs differing in backness: Either a back vowel alternates with a front rounded vowel as in (13a), or a back vowel alternates with a front unrounded vowel, shown in (13b).[8]

(12) Cases with exactly two surface forms

vowel	suffix	example	gloss	no. of suffixes
{y, u}	{yŋk, uŋk}	[eːv-yŋk]	'our year'	7
		[bot-uŋk]	'our stick'	
{yː, uː}	{yː, uː}	[eːv-yː]	'having year'	1
		[bot-uː]	'having stick'	
{ø, o}	{nøk, nok}	[meːr-nøk]	'engineer'	1
		[laːt-nok]	'visionary'	
{øː, oː}	{tøːl, toːl}	[eːf-tøːl]	'from year'	5
		[bot-toːl]	'from stick'	
{ɛ, ɔ}	{bɛn, bɔn}	[tøg-bɛn]	'in marrow'	24
		[bod-bɔn]	'in stick'	
{ɛ, o}	{ɛmeːɲ, omaːɲ}	[ɟyjt-ɛmeːɲ]	'collection'	2
		[rɔk-omaːɲ]	'cargo'	
{eː, aː}	{neːl, naːl}	[tøk-neːl]	'at marrow'	10
		[bot-naːl]	'at stick'	

(13) Additional examples of harmony with two-member morph sets

	a. {yŋk, uŋk}		b. {bɛn, bɔn}	
[front nonround]	[eːv-yŋk]	'our year'	[eːv-bɛn]	'in year'
[front round]	[tøk-yŋk]	'our marrow'	[tøg-bɛn]	'in marrow'
[back]	[bot-uŋk]	'our stick'	[bod-bɔn]	'in stick'
	[fɔl-uŋk]	'our wall'	[fɔl-bɔn]	'in wall'

As seen in both (12) and (13), back harmony is regularly represented in words with these suffixes, but rounding harmony may be violated. In the two-morph sets, the front morphs appear after both round and nonround front roots, regardless of whether the suffix morph is round, like {yŋk} 'our', or nonround, like {bɛn} 'in'.

The phonological analysis of these two-morph suffixes is straightforward if lexical entries involve morph sets, the model in (2). Given a choice between a front morph and a back morph, the *[bk] [fr] phonotactic requires a back vowel after a back vowel (14).

(14) Assessment for [fɔl-uŋk] 'our wall'

morph sets: {fɔl}$_{\text{WALL}}$; {yŋk, uŋk}$_{\text{OUR}}$

	WALL-OUR	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
	a. fɔl-yŋk	*!	*		**
☞	b. fɔl-uŋk		**		**

[8] Of the items in (12), Törkenczy (2011) notes that sets with {ø, o} and {ɛ, o} are highly restricted: for example, only 36 words are found with the suffix {nøk, nok} and 23 with {ɛmeːɲ, omaːɲ}.

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The *[bk] requirement prohibits back vowels after front roots, since there is a choice, illustrated in (15), (16).

(15) Assessment for [eːv-yŋk] 'our year'

morph sets: {eːv, eːf}$_{\text{YEAR}}$; {yŋk, uŋk}$_{\text{OUR}}$

YEAR-OUR	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
👍 a. eːv-yŋk				*
b. eːv-uŋk		*!		*

(16) Assessment for [tøg-bɛn] 'in marrow'

morph sets: {tøk, tøg}$_{\text{MARROW}}$; {bɛn, bɔn}$_{\text{IN}}$

MARROW-IN	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]
👍 a. tøg-bɛn			*	*
b. tøg-bɔn		*!		**

Rounding agreement has no role with suffixes having a two-way alternation because each morph set has both a back and a front variant. Both morphs are rounded in {yŋk, uŋk}$_{\text{OUR}}$, and there is no front rounded morph in {bɛn, bɔn}$_{\text{IN}}$. As seen in (16) the selected form may violate *[rd] [nonrd].

The assessment in (16) motivates ranking the [back] wellformedness pair above the [round] wellformedness pair; otherwise, *[tøg-bɔn] would be incorrectly identified as the preferred compilation.

4.3. Summary

The examples in this section continue to show the crucial role that the morph set plays. Suffix morph sets with different numbers of members correspond to different degrees of harmony. If we assumed the optimality theoretic notion of Gen, there would be no simple reason for preventing additional candidates —such as *[eːv-iŋk] and *[tøg-bøn]— and these candidates would be evaluated as better than the actually occurring forms. Within the Emergent approach, such forms are not even considered because the morph sets have fixed membership; they do not contain morphs that would be fully harmonic, neither *{iŋk} for 'our', nor *{bøn} for 'in'.

The account of Hungarian harmony presented so far involves purely phonological wellformedness, the four conditions *[bk] [fr], *[bk], *[rd] [nonrd], and *[rd]. The contribution of the morphology is to provide the sets of morphs that these conditions operate upon and to limit the domain of harmony wellformedness. As we have shown, the morphology sometimes exempts a lexeme from the coverage of the phonotactics by providing only a single morph; sometimes the morphology provides two morphs, one back and one front; sometimes the morphology provides three morphs, allowing greater satisfaction of the phonotactics.

In the discussion below, we examine several cases where the morphology plays a more direct role in shaping the surface results. We show cases of "anti-harmony", where the morphology imposes a particular suffix variant that is at odds with the phonotactics even though a harmonically well-formed option is available. We show how this morphological property is potentially involved in "transparency". Finally, we discuss a common class of suffixes that include a fourth possible morph, one whose selection depends on the interplay of morphological —as well as phonological— properties.

5. Roots showing lexical class behaviour

We turn first to an unexpected behaviour, where in spite of there being a harmonic morph available, that harmonic morph is not chosen. "Anti-harmony" illustrates this phenomenon, with "transparency" a possible by-product.

5.1. Anti-harmony: Wellformedness limited to a lexical class

As seen above, given a sufficiently differentiated morph set, suffixes harmonise with the backness values of the roots they occur with. Hence with [front, nonround] root vowels, a suffix will also be [front, nonround] (17a). However, as shown in (17b), some roots with the same [front, nonround] vowels are unexpectedly followed by suffixes with [back] vowels.

(17) Hungarian neutral vowel roots (Törkenczy 2011)

a. *harmonic*	*fillér*	[filːeːr]	'penny'	*fillérnek*	[filːeːrnɛk]	'penny-DAT'
	víz	[viːz]	'water'	*víznek*	[viːznɛk]	'water-DAT'
b. *anti-harmonic*	*híd*	[hiːd]	'bridge'	*hídnak*	[hiːdnɔk]	'bridge-DAT'
	derék	[dɛreːk]	'waist'	*deréknak*	[dɛreːknɔk]	'waist-DAT'

Anti-harmonic roots such as in (17b) have prompted abstract analyses involving absolute neutralisation (e.g. Vago 1976), floating features (e.g. Ringen & Vago 1998), etc. However, an abstract phonological label (e.g. a non-occurring segment or floating feature) makes it no less lexically arbitrary (Archangeli & Pulleyblank 2022). In the Emergent approach, such options are not available. Emergence explicitly recognises the precise nature of such cases: an arbitrary lexical class requires an unexpected set of affixal variants. Roots exhibiting this behaviour are assigned membership in some arbitrary class α, a lexical set with its own wellformedness condition, (18), which results in a back affix following morphs of this class as a result of prohibiting the otherwise expected front affix.

(18) Hungarian anti-harmonic roots

$*\{\ \}_{\alpha}$ [front], where α designates a member of the relevant lexical class

The effect of this condition in assessing an affixed class α-root is illustrated in (19).

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(19) Assessment for [hiːdnɔk] ‘bridge-DAT’

morph sets: {hiːd, hiːt}$_{\text{BRIDGE, }\alpha}$; {nɛk, nɔk}$_{\text{DATIVE}}$

BRIDGE-DAT	*{ }$_\alpha$ [front]	*[bk] [fr]	*[bk]
a. hiːd$_\alpha$-nɛk	*!		
☞ b. hiːd$_\alpha$-nɔk			*

In the anti-harmonic roots of (17b), all root vowels are [front]. But this is not a requirement of lexical class α. In the next section, we show that this analysis of anti-harmonic and harmonic roots can extend to disharmonic roots – roots which have an internal [back][front] sequence of vowels.[9] If such roots are in lexical class α, then we expect the pattern called “transparency” in the Hungarian harmony system. We turn to this discussion now.

5.2. Transparency and opacity

The Hungarian phonotactic *[bk] [fr] can be violated within roots: some roots contain a back vowel followed by a front vowel. In these cases, some back-front roots are followed by a back morph, exhibiting *transparency*, (20a); in other cases, the back-front roots are followed by a front suffix, exhibiting *opacity*, (20b).

(20) Hungarian transparency & opacity (Törkenczy 2011)

a. *transparent vowels*	*papír-nak*	[pɔpiːrnɔk]	‘paper-DAT’
	kávé-nak	[kaːveːnɔk]	‘coffee-DAT’
	haver-nak	[hɔvɛrnɔk]	‘pal-DAT’
b. *opaque vowels*	*mutagén-nek*	[mutɔgeːnːɛk]	‘mutagen-DAT’
	kódex-nek	[koːdɛksnɛk]	‘codex-DAT’

Such cases raise issues concerning locality, how close two phonological objects must be in order to interact (Suzuki 1998). If we were to assume strict locality (Gafos 1999; Ní Chiosáin & Padgett 2001) as a requirement on phonological interaction, then the local agreement seen in (20b) would be expected and the apparent skipping of the front vowels in (20a) would be surprising. There has been considerable discussion of such cases in the literature, both on Hungarian (Benus & Gafos 2007) and in general (Archangeli & Pulleyblank 2007; Gafos & Dye 2011; Rose & Walker 2011). Mechanisms have been proposed to render local a relation that is strictly nonlocal; for example, Agreement-By-Correspondence establishes correspondence between elements based on similarity, not proximity, with harmony defined on the corresponding elements (Rose & Walker 2004; Hansson 2010). Alternatively, but not unrelated, harmony could be defined on a tier that excludes the transparent segments; the requirement could be that interacting vowels must be ad-

[9] A root with only back vowels could in principle be assigned to the α-class but the results would be indistinguishable from routine harmony: both *{ }$_\alpha$ [front] and *[bk] [fr] would enforce back suffixes.

jacent on the defined tier (Heinz *et al.* 2011; Jardine 2016; Jardine & Heinz 2016; McMullin 2016).

Whatever the validity of a particular phonological proposal on locality, a central issue for Hungarian is that individual lexemes differ in their behaviour. If opacity is taken as the predicted result (say, through strict locality) then an analysis specific to the cases in (20a) must be found; if transparency is taken as the predicted result (say, through correspondence or tier-based locality) then an analysis specific to the cases in (20b) must be found. Neither tack on the issue removes the requirement for lexically-specific encoding in a language like Hungarian, which exhibits *both* transparency and opacity.

An immediate consequence of the approach advocated here is that a solution has already been introduced. If strict locality is taken as at least the norm, then the roots exhibiting transparency need only be assigned to the α-class. Their behaviour follows, because the morphophonological wellformedness condition $*\{\ \}_{\alpha}$ [front] prevents α-roots from being followed by front vowels. We illustrate with [hɔvɛrnɔk] 'pal-DATIVE' in (21).

(21) Assessment for [hɔvɛrnɔk] 'pal-DATIVE'

morph sets: $\{\text{hɔvɛr}\}_{\text{PAL},\,\alpha}$; $\{\text{nɛk, nɔk}\}_{\text{DATIVE}}$

PAL-DATIVE	$*\{\ \}_{\alpha}$ [front]	*[bk] [fr]	*[bk]
a. hɔvɛr_{α}-nɛk	*!	*	*
☞ b. hɔvɛr_{α}-nɔk		*	**

Opacity is expected under our analysis if there is no α-root: *[bk] prefers a harmonic form with fewer back vowels. We illustrate with [koːdɛksnɛk] 'codex-DATIVE' in (22).

(22) Assessment for [koːdɛksnɛk] 'codex-DATIVE'

morph sets: $\{\text{koːdɛks}\}_{\text{CODEX}}$; $\{\text{nɛk, nɔk}\}_{\text{DATIVE}}$

CODEX-DATIVE	$*\{\ \}_{\alpha}$ [front]	*[bk] [fr]	*[bk]
☞ a. koːdɛks-nɛk		*	*
b. koːdɛks-nɔk		*	**!

Though perhaps surprising to a reader steeped in thinking of transparency as being a nonlocal case of harmony, the Emergent α-class analysis has several desirable properties. First, all phonologically motivated harmony is local in the sense that vowels are never skipped. Second, the properties of all cases involving front nonround vowels are unified, – harmony/anti-harmony and opacity/transparency. Third, this approach explicitly builds in the lexical nature of the distinction between opaque and transparent classes (Törkenczy 2011): Whether a given root is opaque or transparent must be learned.[10]

[10] There are numerous other properties to be worked into a full analysis (Hayes & Londe 2006; Törkenczy 2011), for example, the "count" effect (harmony affected by the number of front unroun-

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5.3. Summary

The key take-away from the discussion of anti-harmonic roots and opaque vs. transparent roots is that an additional type of morphological property interacts with otherwise transparent phonological effects. The phonology imposes phonotactic conditions; the morphology provides morph sets of differing sizes as well as arbitrary lexical classes. Arbitrary morphological classes require class-restricted wellformedness conditions which result in a morphology-phonology interaction in the choice of morphs involving those classes.

In the next section, we return to the issue of lexical classes for suffix morphs as well as for roots. The example also shows that not only can morph sets have 1, 2, or 3 members, they may also have 4 members. The relevant cases combine an expanded morph set with critical morphological class membership.

6. Suffixes showing lexical class behaviour

Some morph sets contain members with four distinct vowel qualities; Törkenczy (2011) identifies 17 productive examples of this type. The plural suffix, for example, exhibits the four variants {ɛk, øk, ɔk, ok}.

(23) Quaternary morph sets, e.g. $\{ɛk, øk, ɔk, ok\}_{\text{PLURAL}}$

a. *gyep*	[ɟɛp]	‘lawn’	*gyepek*	[ɟɛpɛk]
b. *sün*	[ʃyn]	‘hedgehog’	*sünök*	[ʃynøk]
c. *gáz*	[gaːz]	‘gas’	*gázok*	[gaːzok]
d. *ház*	[haːz]	‘house’	*házak*	[haːzɔk]

As seen in (23c/d), the occurrence of {ok} vs. {ɔk} cannot be predicted from the vowel quality of the root. One root type must be assigned some morphologically special status. Our proposal, following previous work (e.g., Siptár & Törkenczy 2000; Törkenczy 2011), is to consider roots of type (23d) as morphologically marked; we label this the β-class.

6.1. Two classes of roots illustrated

We begin with an illustration of the quaternary class with neutral roots in (24) and then go on to β-roots in (27). With neutral roots, the observed suffixes are the same with ternary and quaternary options. Anticipating our analysis, we identify some suffixes as β-class.

ded vowels occurring between a root vowel and a suffix), and “vacillating” roots (roots taking either front or back suffixes). Consider also the “height” effect: it is no accident that the examples of opacity in (20) did not include cases with [i]. As vowels lower, the tendency to be a member of the α-class decreases – the height effect: All mixed roots with [i] are members of the α-class; mixed roots with [eː] tend to be members of the α-class; mixed roots with [ɛ] tend not to be members of the α-class. In the Emergent approach, the tendencies in the data would be learned and mirrored in the assignment of roots to the α-class.

(24) Neutral roots with β-class and neutral suffixes (Törkenczy 2011)

	neutral root			*quaternary β-class suffix* {ok, ɔk$_{\beta}$, ɛk$_{\beta}$, øk}$_{\text{PL}}$		*ternary neutral suffix* {on, ɛn, øn}$_{\text{SUPERESSIVE}}$	
FR UNRD	*gyep*	[ɟɛp]	'lawn'	*gyepek*	[ɟɛpɛk]	*gyepen*	[ɟɛpɛn]
FR RD	*sün*	[ʃyn]	'hedgehog'	*sünök*	[ʃynøk]	*sünön*	[ʃynøn]
	rög	[røg]	'clod'	*rögök*	[røgøk]	*rögön*	[røgøn]
BK	*gáz*	[gaːz]	'gas'	*gázok*	[gaːzok]	*gázon*	[gaːzon]
	bot	[bot]	'stick'	*botok*	[botok]	*boton*	[boton]

With a neutral front unrounded root, back and round harmony require a front unrounded suffix: there is one possible front unrounded morph, {ɛk$_{\beta}$}, in the quaternary set and one possible such morph, {ɛn}, in the ternary set. Similarly with a neutral front rounded root, back and round harmony require a front rounded suffix: again, there is one possible morph of the matching type, {øk}, in the quaternary set and one possible such morph, {øn}, in the ternary set. The only issue arises then with a back root. Given the two back suffix options with a quaternary suffix, {ɔk$_{\beta}$, ok}, we need a general preference for nonlow vowels to bring about the selection of {ok} with a neutral root.

(25) Hungarian lowness phonotactic, *[lo]
*[low] Assign a violation to a form for each low vowel.
$\mathcal{F}$: vowels
$\mathcal{D}$: word

We provisionally rank *[low] below the harmony conditions, not crucially ranked with respect to *[round]. As illustrated with the neutral root *gáz* [gaːz] 'gas', *[low] correctly results in {ok} being preferred to {ɔk$_{\beta}$}; front options, both rounded and unrounded, are excluded by the back harmony conditions.

(26) Assessment for [gaːz-ok] 'gas-PLURAL'

morph sets: {gaːz}$_{\text{GAS}}$; {ok, ɔk$_{\beta}$, ɛk$_{\beta}$, øk}$_{\text{PL}}$

	GAS-PL	*[bk] [fr]	*[bk]	*[rd] [nonrd]	*[rd]	*[lo]
	a. gaːz-ɛk$_{\beta}$	*!	*			**
	b. gaːz-øk	*!	*		*	*
	c. gaːz-ɔk$_{\beta}$		**		*	**!
☞	d. gaːz-ok		**		*	*

Of course, if there wasn't some class of roots that *does* select the low morphs, there would be no reason to posit such suffix morphs at all. As the data in (27) show,

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there is indeed a subset of roots —low-selecting roots, or as we refer to them, 'β-class' roots— that selects the low suffixal variant.[11]

(27) β-class roots with β-class and neutral suffixes

	β-class root			*β-class suffix*		*neutral suffix*	
	root			*quaternary* PLURAL		*ternary* SUPERESSIVE	
				{ok, ɔk$_{\beta}$, ɛk$_{\beta}$, øk}$_{\text{PL}}$		{on, ɛn, øn}$_{\text{SUPERESSIVE}}$	
FR UNRD	*kép*	[keːp]	'picture'	*képek*	[keːpɛk]	*képen*	[keːpɛn]
FR RD	*fül*	[fyl]	'ear'	*fülek*	[fylɛk]	*fülön*	[fyløn]
	szög	[søg]	'nail'	*szögek*	[søgɛk]	*szögön*	[søgøn]
BK	*ház*	[haːz]	'house'	*házak*	[haːzɔk]	*házon*	[haːzon]
	fog	[fog]	'tooth'	*fogak*	[fogɔk]	*fogon*	[fogon]

These cases show the following behaviour. Neutral roots exhibit nonlow variants, where possible, for both ternary and quaternary suffixes; β-roots exhibit the general preference for nonlow variants with ternary suffixes but exhibit low variants with quaternary suffixes. In other words, in order to override the general preference for nonlow vowels, the root must be a member of the β-class and the suffix must be quaternary. Thus, both suffix and root are lexically arbitrary; both are labeled as β-class.

6.2. Motivation for β-class suffixes and * β ¬β

Having given a quick overview of the essence of our analysis, we now give the details. We begin with neutral roots and quaternary suffixes. As seen in (24) and illustrated in the assessment for 'gas-PLURAL' (26), there is a general preference for nonlow vowels – this results in [o] being chosen with neutral roots, whether the suffix is ternary or quaternary. With β-class roots, there is a difference: a low vowel is chosen from the quaternary set, motivating a β-class wellformedness condition requiring a following low vowel: *]$_{\beta}$ [nonlow]. (Anticipating our analysis, we do not formalise this condition because ultimately we reject it in favor of a morphological wellformedness condition *β ¬β.) With a back vowel root like *ház* [haːz] 'house' and quaternary suffixes, *]$_{\beta}$ [nonlow] has the desired effect. With a quaternary suffix like the plural, {ok, ɔk$_{\beta}$, ɛk$_{\beta}$, øk}, two morphs satisfy the requirement for a low vowel: {ɛk$_{\beta}$, ɔk$_{\beta}$}, and routine considerations of back harmony correctly result in surface [haːzɔk]. When the same root occurs with a ternary suffix such as the superessive, {on, ɛn, øn}, there is no morph that satisfies both backness harmony and the requirement to be low; {ɛn} satisfies the lowness requirement but not backness, {on} satisfies the harmonic requirement but not lowness. That the surface form in such a case is [haːzon] motivates ranking back harmony above the putative *]$_{\beta}$ [nonlow] requirement.

[11] Consideration of the front unrounded suffixes, {ɛk$_{\beta}$} and {ɛn}, shows that they are the same after both neutral roots and β-roots in the top row of both (24) and (27). This raises the obvious question of why posit β-roots at all in such cases. We address this question briefly at the end of the section.

We turn to front round roots to explore the ranking with respect to roundness harmony. Unfortunately, the interaction with roundness reveals a conundrum, which leads us to reject the *]$_\beta$ [nonlow] analysis. In order to correctly choose a front *unrounded* vowel in the low-selecting β-class, it is crucial that the *]$_\beta$ [nonlow] condition be ranked above the round harmony conditions. Consider an assessment with a quaternary suffix, and *]$_\beta$ [nonlow] ranked between backness and roundness harmonies, (28). When *]$_\beta$ [nonlow] is ranked between the two harmony systems, [fyl$_\beta$-ɛk$_\beta$] (28c) is correctly identified, preferring a low vowel over a vowel that satisfies rounding harmony. Were *[rd] [nonrd] ranked above *]$_\beta$ [nonlow], *[fyl$_\beta$-øk] would incorrectly be selected.

(28) Assessment for [fylɛk] ‘ear-PLURAL’

morph sets: {fyl}$_{\text{EAR}, \beta}$; {ok, ɔk$_\beta$, ɛk$_\beta$, øk}$_{\text{PL}}$

	EAR-PL	*[bk] [fr]	*[bk]	*]$_\beta$ [nonlow]	*[rd] [nonrd]	*[rd]	*[lo]
	a. fyl$_\beta$-ok		*!	*		**	
	b. fyl$_\beta$-ɔk$_\beta$		*!			**	*
☞	c. fyl$_\beta$-ɛk$_\beta$				*	*	*
	d. fyl$_\beta$-øk			*!		**	

The assessment in (28) argues that *]$_\beta$ [nonlow] needs to be ranked above *[rd] [nonrd]. But the ranking that is successful here produces the wrong result if a β-class root occurs with a ternary suffix: the [low] suffix morph is incorrectly chosen instead of the correct front round morph. Consider [fyl$_\beta$-øn] ‘ear-SUPERESSIVE’.

(29) Assessment for [fyl$_\beta$-øn] ‘ear-SUPERESSIVE’

morph sets: {fyl}$_{\text{EAR}, \beta}$; {ɛn, øn, on}$_{\text{SUPERESSIVE}}$

	EAR-SUPERESSIVE	*[bk] [fr]	*[bk]	*]$_\beta$ [nonlow]	*[rd] [nonrd]	*[rd]	*[lo]
OOPS!	a. fyl$_\beta$-ɛn				*	*	*
(☞)	b. fyl$_\beta$-øn			*!		**	
	c. fyl$_\beta$-on		*!	*		**	

If the *]$_\beta$ [nonlow] condition is more important than round harmony when the root is of class β, then we expect the incorrect *[fyl$_\beta$-ɛn], parallel to [fyl$_\beta$-ɛk]. (Ranking *]$_\beta$ [nonlow] below the round harmony conditions correctly selects [fyl$_\beta$-øn], showing the ranking paradox.)

We conclude that β-roots *in combination with* quaternary suffixes form the necessary conjunction of properties, justifying the β-class label on the quaternary suffixes. The two morphs of a quaternary morph set that occur with β-roots are {ɛk, ɔk}; we mark them as belonging to the β-class of morphs, {ɛk$_\beta$, ɔk$_\beta$}. With some roots and some suffixes assigned to the β-class, we can formulate the relevant wellformedness condition as an instantiation of the *XY schema where both X and Y are morphologically defined classes, as in (30).

(30) β-class wellformedness condition

*β ¬β $\mathcal{F}$: morphs $\mathcal{D}$: word	Assessing morphs only, assign a violation to a form for each sequence of a β-class morph that is followed by a non-β-class morph.

Consider suitably revised assessments for the examples seen in (28) and (29). Note that *β ¬β can force violations of round harmony but not of backness harmony; the ranking of the condition with respect to the back harmony conditions is not crucial.

(31) Assessment for [fylɛk] ‘ear-PLURAL’

morph sets: {fyl}$_{\text{EAR, }\beta}$; {ɛk$_{\beta}$, øk, ɔk$_{\beta}$, ok}pl

EAR-PL	*[bk] [fr]	*[bk]	*β ¬β	*[rd] [nonrd]	*[rd]	*[lo]
a. fyl$_{\beta}$-ok		*!	*		**	
b. fyl$_{\beta}$-ɔk$_{\beta}$		*!			**	*
☞ c. fyl$_{\beta}$-ɛk$_{\beta}$				*	*	*
d. fyl$_{\beta}$-øk			*!		**	

Crucially, *β ¬β can force a violation of roundness harmony, but only if both root and suffix are members of the marked β-class. When a β-root occurs with a neutral ternary suffix, *β ¬β has no effect since it is violated by all compilations; the regular phonological conditions determine the surface form.

(32) Assessment for [fyl$_{\beta}$-øn] ‘ear-SUPERESSIVE’

morph sets: {fyl}$_{\text{EAR, }\beta}$; {ɛn, øn, on}$_{\text{SUPERESSIVE}}$

EAR-SUPERESSIVE	*[bk] [fr]	*[bk]	*β ¬β	*[rd] [nonrd]	*[rd]	*[lo]
a. fyl$_{\beta}$-ɛn			*	*!	*	*
☞ c. fyl$_{\beta}$-øn			*		**	
d. fyl$_{\beta}$-on		*!	*		**	

Before considering how a condition like *β ¬β could emerge, we show briefly that there are no additional problems posed by either back roots or front unrounded roots. Consider first a β-root with a [back] vowel. As seen below, the surface form of a quaternary suffix is both [back] and β, as expected.

(33) Assessment for [haːz-ɔk] 'house-PLURAL'

morph sets: {haːz}$_{\text{HOUSE, }\beta}$; {ɛk$_{\beta}$, øk, ɔk$_{\beta}$, ok}$_{\text{PL}}$

	HOUSE-PL	*[bk] [fr]	*[bk]	*β ¬β	*[rd] [nonrd]	*[rd]	*[lo]
	a. haːz$_{\beta}$-ok		**	*!		*	*
☞	b. haːz$_{\beta}$-ɔk$_{\beta}$		**			*	**
	c. haːz$_{\beta}$-ɛk$_{\beta}$	*!	*				**
	d. haːz$_{\beta}$-øk	*!	*	*		*	*

Similarly, with a β-root containing a front unrounded vowel, the correct form of a quaternary suffix results.

(34) Assessment for [keːp-ɛk] 'picture-PLURAL'

morph sets: {keːp}$_{\text{PICTURE, }\beta}$; {ɛk$_{\beta}$, øk, ɔk$_{\beta}$, ok}$_{\text{PL}}$

	PICTURE-PL	*[bk] [fr]	*[bk]	*β ¬β	*[rd] [nonrd]	*[rd]	*[lo]
	a. keːp$_{\beta}$-ok		*!	*		*	
	b. keːp$_{\beta}$-ɔk$_{\beta}$		*!			*	*
☞	c. keːp$_{\beta}$-ɛk$_{\beta}$						*
	d. keːp$_{\beta}$-øk			*!		*	

As shown back harmony restricts potential results to [keːp$_{\beta}$-ɛk$_{\beta}$] or [keːp$_{\beta}$-øk]; *β ¬β as well as *[rd] prefer the form with {ɛk}.

6.3. Discussion

In closing this section we consider two points. First, why posit a class of β-roots with front unrounded vowels? Second, how would a system like this develop? On the first point, it is important to note that the selection of morphs for the quaternary suffixes is not the only manifestation of membership in the β-class. Another indication of membership in the β-class is suffixal behaviour involving V~Ø; alternations. Siptár and Törkenczy (2000: 225) cite cases such as the following where neutral roots take an accusative form that is a bare consonant, -C, while β-class roots take a -VC form. Note that several of the β-roots in (35) have front, unrounded vowels.

(35) Suffixal V~Ø alternations in the accusative, {ɛt$_{\beta}$, øt, ɔt$_{\beta}$, ot}$_{\text{ACC}}$

neutral roots			β-roots		
sör-t	[ʃør-t]	'beer-ACC.'	*hal-at*	[hɔl$_{\beta}$-ɔt$_{\beta}$]	'fish-ACC.'
lány-t	[laːɲ-t]	'girl-ACC.'	*hány-at*	[haːɲ$_{\beta}$-ɔt$_{\beta}$]	'how many-ACC.'
rés-t	[reːʃ-t]	'gap-ACC.'	*tehen-et*	[tɛhɛn$_{\beta}$-ɛt$_{\beta}$]	'cow-ACC.'
dal-t	[dɔl-t]	'song-ACC.'	*mesz-et*	[mɛs$_{\beta}$-ɛt$_{\beta}$]	'lime-ACC.'
ón-t	[oːn-t]	'tin-ACC.'	*méz-et*	[meːz$_{\beta}$-ɛt$_{\beta}$]	'honey-ACC.'

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A β-root like 'fish' or 'how many' takes the β variant of the accusative, {ɔt$_β$}, while a non-β root would take the nonlow option {ot}, e.g. *nyom-ot* [ɲom-ot] 'trace'. As seen in such cases, roots with front unrounded vowels may be neutral or β-class, just like other roots. It is not, however, within the scope of this paper to discuss the analysis of such V~Ø alternations.

The final point we will touch on is how a β-class might evolve. Siptár and Törkenczy (2000) point towards a plausible answer to this. They point out that there are dialects of Hungarian that distinguish between nonlow [e] and low [ɛ], adding a fifth morph to the quaternary morph sets. In such dialects, the low variants of quaternary suffixes are found specifically after the β-class roots while the nonlow variants are found after neutral roots. In such a dialect, the affixes occurring after a β-root are simply and straightforwardly the phonetically *low* morphs, those with [ɛ, ɔ]. For such dialects, the morpho-phonological condition *β [nonlow] is sufficient instead of the purely morphological *β ¬β condition. In Educated Colloquial Hungarian, the variety considered in detail in most work on Hungarian including Siptár & Törkenczy (2000) and Törkenczy (2011), the distinction between [e] and [ɛ] has been merged to [ɛ]. This merger has, however, left a trace. In the ternary suffixes where there was a nonlow vowel, instances of [ɛ] continue to behave as nonlow; in the quaternary suffixes where there was a low vowel, the [ɛ] acts as 'low'. The merger led to the need to distinguish between different suffixal instances of [ɛ]: those that behave as neutral (ternary suffixes), those that behave as 'low' (quaternary, β suffixes).

In summary, the key point about the β-class is that its effects are not completely phonologically predictable. The general pattern for a morph set containing at least three morphs is that we get a front unrounded variant after front unrounded vowels (consistent with both neutral roots and β-class roots in Educated Colloquial Hungarian), a front rounded variant after front rounded vowels and a back variant after back vowels. β-class roots (an arbitrary class) deviate from this pattern with a phonologically arbitrary set of suffixes, appearing with a front unrounded suffix (which is low) after *all* front roots —both unrounded and rounded— and with a *low* back variant after back roots.

The effect of morphology —systematic or idiosyncratic— is felt in other ways. For example, some derivational suffixes are β-class; inflectional suffixes are all β-class; adjectives are generally β-class (see Siptár & Törkenczy 2000: 224-230). In short, whether a particular lexical item is a member of the β-class is tightly bound up with the morphology. Moreover, as carefully motivated by Siptár and Törkenczy (2000) and illustrated in (35), β-class is only an option with suffixes involving V~Ø alternations, though exhibiting such alternations is not sufficient to predict β-class membership.

In the analysis proposed here, the key to β-class is the interaction of two elements. First, based on their behaviour, some morphs are assigned to the β-class set, idiosyncratically in some cases and regularly in others. Second, assessment of morph compilations selects a β-root followed by a β suffix where possible due to the morphological wellformedness condition *β ¬β. Once these morphological properties are taken care of, harmony itself proceeds in the phonologically expected way: back variants are chosen after back roots and front variants elsewhere, and if compatible with the effects of *β ¬β, rounded variants after rounded roots.

7. Discussion and conclusion

Our analysis handles the basic facts of Hungarian harmony, yet there is more to explore. As mentioned in section 6.3, harmony varies among Hungarian dialects, there are more affix classes than the ones mentioned here and V/Ø alternations interact with harmony. Additionally, along with the anti-harmonic roots, there are a very few disharmonic roots (roots with front round vowels combined with back vowels in either order) and there are a large number of mixed roots (roots with front unround vowels combined with back vowels in either order). Despite ours being a preliminary analysis, there are significant take-aways.

Törkenczy (2011: 2972) observes for Hungarian that "[e]xactly what kind of harmonic behaviour a given stem induces in harmonising suffixes is the lexically arbitrary property of each stem". Our analysis captures this observation through morph set membership – the number of morphs for a specific suffix is arbitrary and whether a morph is or is not a member of the α-class or the β-class is arbitrary. Once lexical representations, appropriately labeled morph sets, are established, the varied harmony patterns emerge when the wellformedness conditions assess lexical compilations. Where do these wellformedness conditions come from?

A fundamental tenet of the Emergent model is that linguistic generalisations arise from skewed distributions. On the one hand, skewing in the phonological distribution of segments may result in the postulation of a phonological wellformedness condition, such as the Hungarian condition prohibiting back-front sequences within words, *[bk][fr]. On the other hand, as word-internal morphological structure is identified, skewing may occur only with certain morphological units, giving rise to lexical classes and to wellformedness conditions that integrate phonological and morphological units, like the Hungarian wellformedness condition driving anti-harmony and transparency, $*\{\ \}_{\alpha}$ [front], and even conditions that refer only to morphological units, such as the Hungarian wellformedness condition for the so-called lowering roots, *β ¬β.

It is not surprising to find lexical class behaviour in a language, and a core property of a human learner is being a rampant generaliser – looking for patterns, even where there might not be any, seems to be a hallmark property of human cognition (Archangeli *et al.* 2011; Mielke *et al.* 2016). Can rampant generalisation result in lexical classes? We divide our answer into two parts. First, how much data is required before formulating a generalisation? Consider the high end of the range. It clearly cannot be the case that learners wait until something approaching *all* of the relevant language data has been encountered. Such a process would presumably mean years of collating data without formulating generalisations. Given the open-ended nature of the lexicon, it is unclear how a learner would ever decide that enough data had been encountered. So while such a hypothesis might result in quite accurate encoding of pattern distribution, it is a highly implausible model for human learning. The alternative is a model where skewings are noted and formulated even with very small amounts of data. This has the benefit of not requiring extensive data collation. The learner needs to consider some small number *n* of examples, noting asymmetries in those forms and expressing them as conditions. Acquisition research (Gerken & Bollt 2008; Gerken *et al.* 2015) suggests that as few as 3 examples are sufficient for a human child to establish a linguistic pattern.

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But doesn't this lead to spurious generalisations? Such a bottom-up, data-driven model of pattern formulation —requiring only a small number of examples to formulate a pattern— requires certain assumptions. Foremost, patterns that are established must also be capable of being weakened or abandoned. Mistakes by the learner will certainly be made, cases where a pattern is established on the basis of some randomly "patterned" data which do not represent an actual pattern in the language. Our assumptions are simple. As data consistent with a postulated pattern are encountered, the pattern is strengthened; as data inconsistent with a pattern are encountered, the pattern is weakened. The learner is more likely to encounter robust patterns than weakly instantiated patterns, so the learner is both more likely to encounter actual patterns than specious patterns and more likely to subsequently encounter confirming data than contradictory data. (See Gerken & Quam 2016 on spurious generalisations in acquisition.)

All of this is consistent with a language exhibiting patterns that are imperfect. Skewed data may be encountered, a condition may be established, the condition may be supported enough of the time that the condition is strengthened, but the condition may also be violated in some number of examples. Concretely, this sort of situation for harmony would involve a case where a harmonic condition is posited on the basis of skewings within morphs – even though not all morphs show the pattern. As we have shown here, Hungarian is just such a language.

References

Archangeli, Diana. 1988. Aspects of underspecification theory. *Phonology* 5. 183-207.

Archangeli, Diana, Adam Baker & Jeff Mielke. 2011. Categorization and features: Evidence from American English /r/. In Rachid Ridouane & G. N. Clements (eds.), *Where do Phonological Contrasts Come From?*, 173-196. Amsterdam: John Benjamins. https://doi.org/10.1017/S0952675711000029.

Archangeli, Diana & Douglas Pulleyblank. 2007. Harmony. In Paul de Lacy (ed.), *The Cambridge Handbook of Phonology*, 353-378. Cambridge: Cambridge University Press.

Archangeli, Diana & Douglas Pulleyblank. 2016. Emergent morphology. In Daniel Siddiqi & Heidi Harley (ed.), *Morphological Metatheory*, 237-270. Amsterdam: John Benjamins.

Archangeli, Diana & Douglas Pulleyblank. 2018. Phonology as an emergent system. In S. J. Hannahs & Anna Bosch (eds.), *The Routledge Handbook of Phonological Theory*, 476-503. London: Routledge.

Archangeli, Diana & Douglas Pulleyblank. 2022. *Emergent Phonology* (*Conceptual Foundations of Language Science* 7). Berlin: Language Science Press. https://doi.org./10.5281/zenodo.5721158.

Benus, Stefan & Adamantios Gafos. 2007. Articulatory characteristics of Hungarian 'transparent' vowels. *Journal of Phonetics* 35. 271-300.

Gafos, Adamantios. 1999. *The Articulatory Basis of Locality in Phonology*. New York: Garland.

Gafos, Adamantios & Amanda Dye. 2011. Vowel harmony: Opaque and transparent vowels. In Marc van Oostendoorp, Colin J. Ewen, Elizabeth Hume & Keren Rice (eds.), *The Blackwell Companion to Phonology, volume IV: Phonological Interfaces*, 2164-2189. Wiley-Blackwell, Malden, MA & Oxford.

Gerken, LouAnn & Alex Bollt. 2008. Three exemplars allow at least some linguistic generalizations: Implications for generalization mechanisms and constraints. *Language Learning and Development* 4. 228-248.

Gerken, LouAnn, Colin Dawson, Razanne Chatila & Josh Tenenbaum. 2015. Surprise! Infants consider possible bases of generalization for a single input example. *Developmental science* 18(1). 80-89.

Gerken, LouAnn & Carolyn Quam. 2016. Infant learning is influenced by local spurious generalizations. *Developmental science*. https://doi.org/10.1111/desc.12410.

Hansson, Gunnar Ólafur. 2010. *Consonant Harmony: Long-Distance Interaction in Phonology* (*University of California Publications in Linguistics* 145). Berkeley, CA: University of California Press.

Hayes, Bruce & Zsuzsa Cziráky Londe. 2006. Stochastic phonological knowledge: The case of Hungarian vowel harmony. *Phonology* 23. 59-104.

Hayes, Bruce, Kie Zuraw, Péter Siptár & Zsuzsa Cziráky Londe. 2009. Natural and unnatural constraints in Hungarian vowel harmony. *Language* 85. 822-863.

Heinz, Jeffrey, Chetan Rawal & Herbert Tanner. 2011. Tier-based strictly local constraints for phonology. In Dekang Lin, Yuji Matsumoto & Rada Mihalcea (eds.), *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human language technologies*, 58-64. Portland, Oregon: Association for Computational Linguistics.

Jardine, Adam. 2016. Learning tiers for long-distance phonotactics. In Laurel Perkins, Rachel Dudley, Juliana Gerard & Kasia Hitczenko (eds.), *Proceedings of the 6th Conference on Generative Approaches to Language Acquisition North America* (*GALANA 2015)*, 60-72. Somerville, MA: Cascadilla Proceedings Project.

Jardine, Adam & Jeffrey Heinz. 2016. Learning tier-based strictly 2-local languages. *Transactions of the Association for Computational Linguistics* 4. 87-98.

McMullin, Kevin James. 2016. *Tier-based locality in long-distance phonotactics: Learnability and typology*. Vancouver, BC: University of British Columbia doctoral dissertation.

Mielke, Jeff, Adam Baker & Diana Archangeli. 2016. Individual-level contact reduces phonological complexity: Evidence from bunched and retroflex /ɹ/. *Language* 92. 101-140.

Mohanan, Karuvannur Puthanveettil, Diana Archangeli & Douglas Pulleyblank. 2010. The emergence of optimality theory. In Linda Ann Uyechi & Lian-Hee Wee (eds.), *Reality exploration and discovery: Pattern interaction in language and life*, 143-158. Stanford: Center for the Study of Language and Information, Stanford University.

Ní Chiosáin, Máire & Jaye Padgett. 2001. *Markedness, segment realization, and locality in spreading*. In Linda Lombardi (ed.), *Segmental Phonology in Optimality Theory*, 118-156. Cambridge: Cambridge University Press.

Prince, Alan & Paul Smolensky. 1993. *Optimality Theory. Constraint Interaction in Generative Grammar* (*RuCCS Technical Report* 2). New Brunswick, NJ: Rutgers University Center for Cognitive Science.

Ringen, Catherine & Robert Vago. 1998. Hungarian vowel harmony in Optimality Theory. *Phonology* 15. 393-416.

Rose, Sharon & Rachel Walker. 2004. A typology of consonant agreement as correspondence. *Language* 80. 475-531.

https://doi.org/10.1387/asju.25948

Rose, Sharon & Rachel Walker. 2011. Harmony systems. In John Goldsmith, Jason Riggle & Alan C. Yu (eds.), *The Handbook of Phonological Theory*. 2nd edn., 240-290. Malden, MA & Oxford: Wiley-Blackwell.

Siptár, Péter & Miklós Törkenczy. 2000. *The phonology of Hungarian*. Oxford: Oxford University Press.

Suzuki, Keiichiro. 1998. *A Typological Investigation of Dissimilation*. University of Arizona doctoral dissertation.

Törkenczy, Miklós. 2011. Hungarian vowel harmony. In Marc van Oostendoorp, Colin J. Ewen, Elizabeth Hume & Keren Rice (eds.), *The Blackwell Companion to Phonology*, 2963-2990. Malden, MA & Oxford: Wiley-Blackwell.

Vago, Robert. 1976. Theoretical implications of Hungarian vowel harmony. *Linguistic Inquiry* 7. 243-263.