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Gaps and repairs at the phonology–morphology interface[1]

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The paper discusses phonologically motivated gaps in inflectional paradigms. A model is offered in which the appearance of gaps is based on a tension between markedness constraints, faithfulness constraints, and constraints which require the expression of morphological categories. After presenting the model, additional implications are analyzed. Situations in which the same problem has different solutions in different morphological contexts are predicted insofar as constraints requiring the expression of different categories can vary in their ranking relative to some faithfulness constraint. Hence, the same phonotactic problem can yield a gap in one situation and a repair in another. This prediction is illustrated and further details of the prediction are explored, including the identification of a situation requiring a more restrictive version of the model. This is achieved by drawing on Smith's (2001) proposal that faithfulness constraints can be indexed to lexical categories to model this situation.

1. Introduction

Any word generated by the morphology of a language must be reviewed by the phonology to determine whether it is well-formed. When the output of the morphology is not phonologically well-formed, the phonology will most often kick in to repair the word, perhaps by changing a feature specification, or by inserting a segment, or perhaps by shifting the location of stress.

But there is another option which the grammar might take. Instead of repairing the offending output, the grammar may simply leave the word unformed, declaring instead that a particular combination of morphemes is for phonological reasons unutterable. The attempt at word-formation fails

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and the grammar abandons hope for expressing a concept synthetically. Instead, it must turn to periphrasis or circumlocution as the only strategies for articulating the intended notion.

The situation described here is one which leads to a gap in a paradigm. Phonologically motivated gaps in paradigms present a fundamental challenge to Optimality Theory (OT) because they would seem to be situations in which some input has no output. Yet perhaps the most central architectural property of an OT analysis is that every input does have some ouput, however unfaithful it may be. The focus of this article is to explore some implications of a strategy for modeling gaps within the framework of Optimality Theory.

In pursuing such a model, we claim that these gaps are not simply accidental diachronic residue, but are instead a possible result of a grammar. That is, a synchronic process of word formation can be thwarted by the phonology and result in no output. This perspective entails the claim that a model of synchronic grammatical knowledge must include a strategy for representing phonologically grounded failures of the morphology. This claim is theory- or model-independent and the material presented below should therefore provide fodder for work in any framework addressing the phonology–morphology interface.

2. Examples of phonologically motivated gaps

Before turning to our primary empirical focus here, namely gaps in Norwegian verbal paradigms, a few other cases will be sketched, to illustrate the type and range of phenomena under consideration.

2.1 *Turkish suffixation*

The grammar of Turkish imposes a disyllabic minimality requirement on the output of suffixation (Ito & Hankamer 1989, Orgun & Sprouse 1999, Raffelsiefen 2004), although Inkelas & Orgun (1995) note that there are varieties of Turkish in which the minimality requirement is not observed. When a CV stem gets a consonantal suffix, the minimality requirement is not met, and suffixation fails, leaving an incomplete paradigm, as seen in (1a), which has a gap for the genitive singular. Epenthesis is available as a repair in the language, but only to fix phonotactic infelicities, such as the derived [lm] cluster in (1b) Epenthesis is not available to fix the templatic inadequacy of (1a).

(1) *Disyllabic minimality for bimorphemic Turkish words*
  (a) (i) do: 'musical note C'
    (ii) *do:-m 'my C'
  (b) (i) sol^{y} 'musical note G'
    (ii) sol^{y}-üm 'my G'

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2.2 *Swedish neuter adjectives*

When an adjective in Swedish is masculine, it has no ending, while the the neuter form is inflected, as seen in (2).

(2) *Well-formed neuter marking in Swedish*
  (a) en rysk pojke (masc.) 'a Russian boy'
  (b) et rysk-t barn (neut.) 'a Russian child'

However, when an adjective has a short vowel followed by the voiced coronal stop [d], as in (3), it cannot be used in such constructions with a neuter noun (Eliasson 1975, Iverson 1981).

(3) *Ill-formed neuter marking in Swedish*
  (a) en redd pojke (masc.) 'a scared boy'
  (b) *et redd-t barn (neut.) 'a scared child'

The ungrammatical form in (3b) is not repaired by voicing assimilation or epenthesis or any other imaginable strategy. Rather, the neuter form of the adjective is unutterable.

The ungrammaticality of **redd-t* in (3b) is due to the infelicity of [dt] as a coda cluster and to a grammar in which repair by devoicing the geminate [d] (or voicing the suffix) is not possible. This prohibition on devoicing is restricted to monomorphemic geminates – true geminates – which are representationally distinct from derived clusters, cf. Rice (2006a). This is clear from the well-formed neuter participle *forberedt* 'prepared' in which the orthographic *dt* corresponds to a voiceless cluster [tt]. This neuter participle is derived from the stem *forbered* via the participle *forberedd*. Adding a *-t* to this participle unproblematically yields a form repaired with devoicing and cluster simplification, in contrast with the attempt to add a *-t* to *redd*, which gives a gap, as in (3).

2.3 *Hungarian CCik verbs*

A triconsonantal cluster yielded by the concatenative morphology of Hungarian cannot surface as such; it must either undergo epenthesis, or be avoided (Hetzron 1975, Törkenczy 2002, Rebrus & Törkenczy To appear). Avoidance is the most popular strategy, cf. Papp (1969), a representative example of which is given in (4).

(4) *A fragment of a Hungarian verbal paradigm*
  (a) csuklani 'to hiccup'
  (b) csuklottam 'I hiccupped'
  (c) csuklik 'he hiccups'
  (d) *csuklhat 'he may hiccup'

The consonant-initial suffix *-hat* cannot be attached to the stem *csukl* 'hiccup', with the result that the form for 'he may hiccup' is left unformed.

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2.4 *Mandarin Chinese distributive reduplication*

Classifiers in Mandarin Chinese can be reduplicated to produce a distributive form, cf. (5).

(5) *Monosyllabic classifier reduplication in Mandarin Chinese*
  (a) dun 'ton' – dundun 'every ton, tons of'
  (b) bei 'cup' – beibei 'every cup, cups'
  (c) ping 'bottle' – pingping 'every bottle, bottles of'

However, this process is active only for the monosyllabic classifiers. The disyllabic ones fail to undergo reduplication, and therefore lack a reduplicated form expressing the distributive (Walker & Feng 2004).

(6) *Disyllabic classifier* (*non*)*reduplication in Mandarin Chinese*
  (a) jialun 'gallon' – *jialunjialun
  (b) chabei 'teacup' – *chabeichabei
  (c) jiuping 'wine bottle' – *jiupingjiuping

Walker & Feng (2004) suggest that reduplication serves not only to express the distributive but also to satisfy a preference that words are minimally disyllabic. When the motivation to satisfy a minimal word requirement is lacking, the markedness violations incurred by the reduplicative form – which follow from Walker & Feng's formal representation of reduplication, cf. Struijke (2002) – are sufficient to compel the non-expression of the distributive morpheme.

2.5 *Hebrew plurals*

In Modern Hebrew, there is a correlation between word size, perceived native status of a word, and stress mobility (Becker 2003). The roots of words with mobile stress are maximally disyllabic in the singular and perceived as native. (See Becker on the opacity resulting from inserted schwas.)

(7) *Mobile stress on native singular-plural pairs in Hebrew*
  (a) dód – dod-ím 'uncle'
  (b) dikdúk – dikduk-ím 'grammar'

Longer stems have come into the language through borrowing, but these all have fixed stress. There are also shorter words lacking perceived native status, and these have fixed stress as well.

(8) *Fixed stress on non-native singular-plural pairs in Hebrew*
  (a) tút – tút-im 'strawberry'
  (b) pílpel – pílpel-im 'bell pepper'
  (c) diktátor – diktátor-im 'dictator'
  (d) fonológ – fonológ-im 'phonologist'
  (e) kópirayter – kópirayter-im 'copywriter'

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Becker (2003) argues that ineffability arises with words which have more than two syllables, but which have some surface phonological properties of the native vocabulary, such that they are perceived as native. He reports, for example, that speakers decline to form the plural of the words in (9) – a claim which I have independently confirmed.

(9) *Hebrew singulars with no plural forms*
  (a) duxifát 'hoopoe'
  (b) ʔizdaréxet 'Chinaberry tree'

In (9b), the final *-et* gets parsed as a suffix contributing to the perception that the word is native. Removing that syllable still leaves a trisyllabic form, which is too long to have mobile stress, but since it is perceived as native, it must have mobile stress on the plural. Hence, the attempt to form the plural is abandoned.

Becker's (personal communication) explanation of form (9a) is somewhat more elaborate. The final stressed syllable appears to be a native suffix, leading the speaker to perceive the form as native. However, that particular suffix only appears inside compounds, and since (9a) is not a compound, the speaker resists removing the final syllable to form a plural *duxif-ót*, which is in principle well-formed. On the other hand, treating the form as a long word with a fixed stress thus yielding *duxifát-im* as the plural, is not satisfactory either, given that the word is perceived as native, and given that such words should have mobile stress. (The selection of *-ot* or *-im* is mostly a matter of grammatical gender, but there are exceptions in just the kinds of cases under consideration, the details of which are beyond the scope of this paper.) Since neither of these options is satisfactory, the opportunity to form the plural is again foregone.

2.6 *Tagalog infixation*

The Tagalog actor-focus morpheme *-um* is much-discussed in the OT literature, including references such as Prince & Smolensky (1993), Orgun & Sprouse (1999), Crowhurst (2001), McCarthy (2003), Klein (2005). As is well known, this morpheme can appear after the first consonant in a word, as in (10a), or even after the first cluster, as in (10b). However, if the initial consonant is a sonorant labial, then affixation cannot occur, (10c). This instance of ineffability is proposed to be motivated by the joint effects of requiring that the affix come early in the word, along with a specific OCP requirement on sequential onsets of a particular flavor.

(10) *Well- and ill-formed affixation in Tagalog*
  (a) sulat – s**um**ulat 'to write'
  (b) preno – pr**um**eno ~ p**um**reno 'to brake'
  (c) mahal – *m**um**ahal 'to become expensive'

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2.7 *English* schm-*reduplication*

To underscore the synchronic nature of gap formation, we offer for consideration one specific detail of English schm-reduplication, based on Nevins & Vaux's (2003) creative elucidation of these facts. Greatly oversimplifying the careful description given by Nevins & Vaux, this process takes inputs and reduplicates them, replacing a consonant or consonant cluster with the cluster *schm*. Some examples are given in (11).

(11) *English* schm-*reduplication*
  (a) Oedipus-schmoedipus
  (b) Holiday-schmoliday
  (c) Pedro-schmedro

Schm-reduplication is productive and at times subtle in its realization. An insurmountable challenge is met when applying the process to targets which begin with *schm*. For many speakers, such targets lead to gaps. That is, no reduplicated form can be constructed on the basis of such stems. Examples are given in (12).

(12) *Gaps in* schm-*reduplication*
  (a) Schmidt: *Schmidt-Schmidt
  (b) Schmooze: *schmooze-schmooze
  (c) Schmuck: *schmuck-schmuck

We assume here that on the basis of relatively limited exposure, speakers generalize the schm-reduplication process and are able to apply it to novel forms and structures. Their generalization must be such that it fails to apply to schm-initial words, i.e. modeling the process entails also modeling the inability to reduplicate stems such as those in (12).

2.8 *Norwegian imperatives*

Consider now imperative formation in Norwegian (Kristoffersen 1991, Rice 2003, 2005). Norwegian imperatives are identical to their roots, while infinitives (for consonant-final roots) show affixation of a final schwa. As a result, we find infinitive-imperative pairs of the variety seen in (13).

(13) *Well-formed Norwegian imperatives*
  (a) å spise – spis! '(to) eat'
  (b) å snakke – snakk! '(to) talk'
  (c) å løfte – løft! '(to) lift'

However, when a root ends in a consonant cluster with rising sonority, there may be a gap for the infinitive, as in (14). The expected result from the morphology is an imperative identical to the root. However a monosyllabic expression of the root will be ill-formed. As noted in Rice

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(2003), and as will be discussed in greater detail below, there is dialectal variation in the response to this situation, but the most common response, to which we here attend, is that the attempt to form an imperative comes to naught.

(14) *Ill-formed Norwegian imperatives*
(a) å åpne – *åpn! 'open'
(b) å padle – *padl! 'paddle'
(c) å sykle – *sykl! 'bike'

The appearance of a gap in an inflectional paradigm reflects a speaker's synchronic knowledge, and it will therefore be incumbent upon a theory of grammar to speak to these cases. In the case of Norwegian imperatives, there is solid evidence that the phenomenon is properly construed as synchronic and we make a brief digression here to present this evidence here.

The claim above that the imperatives in (14) are unutterable is somewhat imprecise because these imperatives do in fact surface when they are followed by a vowel-initial word. This fact is taken here as evidence that speakers do indeed master the morphology of these words.

Following Golston's (1995) proposal that phonology can select between syntactic options, Rice & Svenonius (1998) note that the negative imperative in Norwegian has two possible word orders. The negator *ikke* can come either before or after the imperative, as in (15).

(15) *Syntactic variability with Norwegian negative imperatives*
(a) Hopp ikke på møblene.
jump not on the.furniture
'Don't jump on the furniture!'
(b) Ikke hopp på møblene.
not jump on the.furniture
'Don't jump on the furniture!'

However, when the imperative is of the type in (14) only one of the two syntactic possibilities is well-formed. In this case, *ikke* must follow the imperative if it is to be uttered, assuming that the next word is consonant-initial. Otherwise, the imperative would be followed by a consonant-initial word and would therefore be unutterable, as in (16).

(16) *Phonology selects among syntactic options*
(a) Klatr ikke på møblene.
climb not on the.furniture
'Don't climb on the furniture!'
(b) *Ikke klatr på møblene.
climb not on the.furniture
'Don't climb on the furniture!'

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Note that this is not a fact specifically about negated imperatives; these simply provide a convenient example because *ikke* is vowel-initial. The point could just as well be made with the examples in (17), where the contrast involves prepositions which differ in being vowel-initial or consonant-initial.

(17) *Phonology forbids a consonant-initial preposition*
  (a) Sykl opp bakken.
  bike up the.hill
  'Bike up the hill!'
  (b) *Sykl ned bakken.
  bike down the.hill
  'Bikedown the hill!'

And, of course, both options for the negated imperative return if the subsequent word is vowel-initial, as in (18) with the preposition *opp* 'up'.

(18) *Negative imperative syntactic optionality recovered*
  (a) Klatr ikke opp på møblene.
  climb not up on the.furniture
  'Don't' climb up onto the furniture.'
  (b) Ikke klatr opp på møblene.
  not climb up on the.furniture
  'Don't' climb up onto the furniture.'

These data underscore the synchrony of the phenomenon. Speakers can form the imperative, even when the root has a cluster of rising sonority, but only in the correct phrasal environment – specifically, an environment in which the cluster is heterosyllabic. The gaps under consideration here are not merely the reflex of a diachronic development. They are the result of a synchronic process in the grammar, and a model of the grammar must therefore offer a representation of such processes.

We have seen in this section several examples of phonologically motivated gaps in paradigms, ranging across various categories. Hungarian and Norwegian show gaps in their verbal paradigms, while Turkish and Hebrew show gaps in their nominal paradigms. In Swedish, we see a gap in the adjectives, while Chinese shows one in the classifier system. And even in a language game like English schm-reduplication, we have seen that phonologically motivated gaps can arise.

3. Optimal gaps

We begin this section with a discussion of the theoretical importance of the data in §2. This is followed by a presentation of the theoretical framework in which we model the phenomenon, before we turn to some implications of this approach in the next section.

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3.1 *The theoretical challenge*

Gaps of the type sketched above present a fundamental challenge to Optimality Theory. The architecture of OT is such that every input must be mapped onto some output. Constraints in OT are violable; there is no requirement that the optimal output be perfect. Hence an unfaithful candidate – which we might informally describe as one showing a repair – can easily be the best output.

There is no possibility of a 'crash' in OT, whereby some input may be mapped onto no output. Yet, gaps would appear to be just this situation. The architecture of OT must allow a strategy to model gaps; it must allow *something* to be mapped onto *nothing*.

This problem has been recognized from the start and various solutions have been proposed over the life of the theory. The first proposal is found already in Prince & Smolensky (1993), where an approach invoking the *null parse* is developed. The null parse is a candidate which is in some crucial sense incomplete; Prince & Smolensky propose that it lacks a morphological category, and therefore violates the constraint MPARSE, which requires an output to have a morphological parse. When MPARSE is sufficiently low-ranked, the null parse may be optimal. When it is, its ill-formedness makes it "uniquely unsuited to life in the outside world" (Prince & Smolensky 1993:51). In other words, even though the candidate is optimal in the phonology, it is nonetheless unpronounceable and thereby surfaces unuttered.

The strategy of optimizing the null parse via a low-ranked constraint MPARSE runs into various technical problems. We must determine, for example, which other constraints the null parse violates; indeed, we must consider multiple null parses, differing with respect to their performance on other constraints. To suppress this discussion, McCarthy (2002) offers a development of Prince & Smolensky's proposal, positing instead a *null output*, which has "no structure whatsoever" (McCarthy 2002: 197). Of course, an output with no structure whatsoever is an output in which all elements of the input have been deleted, leading to massive violation of MAX. This problem is circumvented by the stipulation that the null output "always and only" violates MPARSE. For recent work eliminating this stipulation, see McCarthy & Wolf (2005).

The other major proposal for modeling gaps is Orgun & Sprouse's (1999) CONTROL theory. CONTROL is posited as a component of the grammar with 'hard' constraints. The candidate which wins in EVAL is then submitted to the control component. If that candidate violates a hard constraint, then there is no output for the given input. Additional discussion of the CONTROL strategy is found in Fanselow & Féry (2002) and Raffelsiefen (2005).

We aspire here to develop an approach which preserves the core architecture of OT, which avoids the introduction of hard constraints, which

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allows us to eliminate the null output as a candidate along with its stipulative relationship to MPARSE, but which nonetheless acknowledges that some inputs have no well-formed output.

3.2 *Optimal paradigms*

The framework to be used here for analyzing gaps builds on McCarthy's (2005) optimal paradigms theory, as further developed in Rice (2005). The leading idea in optimal paradigms theory is that candidates are paradigms. Analyses carried out in this approach compare candidate paradigms which vary along familiar parameters, achieving conformity with or violation of various markedness and faithfulness constraints.

One natural point of variation among candidates, given this approach, will be in the number of members of a paradigm. If a paradigm, for example, should express six different morphological categories, then alongside a candidate paradigm which does indeed express all six of those categories, we must consider a candidate paradigm which fails to express some of them. In other words, some candidate paradigms will show gaps.

This approach requires including in our theory constraints which punish gaps, cf. discussion in Rice (2005). To this end, we use MAX{CAT} constraints, which require the expression of some morphological category, suggesting a parallel to the use of MAX constraints to punish the non-realization of phonological material. (cf. Kager (2000) for related discussion.) A grammar which selects as optimal a complete paradigm – even if some members of the paradigm have undergone repair – is one in which the MAX{CAT} constraints for the categories to be expressed are relatively highly ranked, at least with respect to faithfulness. When a MAX{CAT} constraint is dominated by markedness and faithfulness, then it may be the case that the least costly imperfection is the non-realization of a category, if this allows a candidate to achieve superior performance on the markedness and faithfulness constraints.

The situation in which a candidate paradigm with a gap may be optimal is illustrated with the simple tableau in (19). We imagine with this tableau a paradigm for the root /sykl/ consisting of two members, specifically an infinitive and an imperative.

(19) *Optimizing a defective paradigm*

	sykl {inf., imp.}	SONSEQ	ID(VOI)$_{IO}$	MAX{IMP.}
a.	sykle$_{inf.}$, sykl$_{imp.}$	*!		
b.	sykle$_{inf.}$, sykl$_{imp.}$		*!	
☞ c.	sykle$_{inf.}$			*

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Three candidates paradigms are considered. In (19a), the infinitive appears, having undergone the usual morphological process of schwa-affixation (represented here with orthographic 'e'), and the imperative appears, having undergone the usual process of zero-affixation. This candidate is fully faithful and it therefore satisfies the faithfulness constraint ID(VOI)$_{IO}$. It also expresses both of the morphological categories, satisfying both MAX{IMP.} and MAX{INF.}, the latter of which is not shown in the tableau because it is unproblematic for the analysis.

The problem with (19a) involves markedness. When the stem ends in a cluster with rising sonority, the attempt to form a monosyllabic imperative will yield a form which violates SONSEQ. Given that this constraint is highly ranked in the grammar, its violation proves fatal.

With (19b) we explore a strategy to satisfy the markedness requirement encoded in SONSEQ. The sonorant of the cluster is devoiced, which yields a sonority profile sufficient to avoid violation of this constraint. Indeed, as discussed in Rice (2003), this is actually a strategy which speakers of other varieties of Norwegian use to avoid a gap for the imperative, when the consonant preceding the sonorant is itself voiceless. Although the sequence [kl̥] does satisfy SONSEQ, devoicing the input /l/ earns a violation of ID(VOI)$_{IO}$. With the grammar and candidates under consideration, this violation is fatal.

Candidate (19c) illustrates an attempt to avoid the markedness violation of the fully faithful candidate (a) while simultaneously avoiding the faithfulness violation of candidate (b). This is achieved by offering a defective paradigm as a candidate. Specifically, the paradigm lacks an expression of the imperative morpheme. Such a gap must be punished; this is achieved by awarding a violation of MAX{IMP.}. With the ranking in this tableau, priority is given to the satisfaction of both faithfulness and markedness. This grammar allows one to go so far as to favor a defective paradigm in order to respect the requirements of faithfulness and markedness.

Representing this situation schematically in (20), our core argument and illustration here have focussed on a situation in which a defective candidate paradigm is punished by a MAX{CAT} constraint. The dominance of this constraint by both markedness and faithfulness may lead to a situation – if the fully faithful candidate violates markedness – in which a candidate paradigm with a gap is nonetheless the most harmonic choice.

(20) *A ranking which favors gaps*
MARKEDNESS, FAITHFULNESS ≫ MAX{CAT}

This approach to gaps emphasizes that they arise at an interface. The gap is a result of the interaction of morphology and phonology, specifically the interaction of a requirement to realize a morpheme with phonological well-formedness requirements. This result is achieved without a placeholder null output and without a row in a tableau which has 'nothing' as its only content. Instead, 'nothing' is accounted for as a phonological fact via the

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defectivity of a paradigm. Our suggestion is that the strategy offered above gives an account which captures the insight that gaps happen at the interface, but without the troublesome ontology of the null output.

4. Same problem; different solutions

The *optimal gaps* approach presented in §3 posits a constraint for each morphological category, requiring its expression. A complete paradigm will be optimal when these constraints are relatively highly ranked, as noted above. But the various Max{cat} constraints need not be ranked as a single block. Following the core OT idea of a factorial typology of constraints, the Max{cat} constraints may of course find themselves spread throughout the constraint hierarchy. (Cf. McCarthy & Wolf (2005) for related discussion.)

In this section, a number of predictions related to this observation are explored. We begin by examining in §4.1 the implications of locating different Max{cat} constraints at different points in the constraint hierarchy, including an analysis of additional Norwegian data which is possible only with the hierarchical non-adjacency of two Max{cat} constraints.

Pushing the discussion of reranking further, we illustrate in §4.2 that our model makes a very specific prediction about the constellation of repairs and gaps which any one language should show; this prediction turns out to be too strong, as demonstrated in §4.3. In §4.4, we see that the theory can be tightened up using independently motivated restrictions, eliminating the incorrect prediction, but leaving us nonetheless with a specific expectation about the relationship between gaps and repairs in any particular morphological category, as discussed in §4.5.

4.1 *One repair, one gap*

The particular ranking to be considered here is one in which a faithfulness constraint is flanked by two Max{cat} constraints, as schematized in (21).

(21) Max{cat} *constraints flank faithfulness*
Markedness ≫ Max{cat_1} ≫ Faithfulness ≫ Max{cat_2}

Assume that Cat_1 and Cat_2 each encounter the same markedness problem, such that in both cases, the fully faithful candidate will violate the highly ranked markedness constraint. Under these circumstances, the grammar in (21) delivers different fates to the two categories.

For each category, we will consider the relative merits of phonologically unfaithful expression as compared with nonexpression. Because Max{cat_1} dominates faithfulness, the category should be expressed, even when doing so requires unfaithfulness to the input. However, Max{cat_2} is itself ranked below faithfulness, such that unfaithfulness is more costly than silence.

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Hence, we expect CAT_1 to be realized and we expect a gap in the paradigm at CAT_2.

The architecture of the proposed theory is such that this situation is easily described, and we can be heartened in our adoption of this approach insofar as we are indeed able to find examples of exactly this situation. Here we focus on one such case, which arises when we extend our study of Norwegian morphology to the realm of the noun.

For some roots in Norwegian, it is possible to form both nouns and verbs. The singular form of the noun has no suffix, such that the singular in the nominal paradigm and the imperative in the verbal paradigm should be identical. This is indeed the case, as seen in (22).

(22) *Identical imperatives and singulars in Norwegian*
  (a) *skriv!* 'write!'; (*et*) *skriv* '(a) document'
  (b) *kost!* 'sweep!'; (*en*) *kost* '(a) broom'
  (c) *dans!* 'dance!'; (*en*) *dans* '(a) dance'
  (d) *kast!* 'throw!'; (*en*) *kast* '(a) throw'

As we have already seen, some roots end in clusters with rising sonority, and these are the ones which are of interest here as well. When both singulars and imperatives are formed by zero affixation, we find two different morphological categories encountering the same phonological problem, namely violation of SonSeq. A few relevant roots are seen in (23).

(23) *Roots ending in clusters with rising sonority*
  (a) /sykl/ 'bike'
  (b) /adl/ 'nobility'
  (c) /hindr/ 'hinder'
  (d) /ordn/ 'arrange'

When one of these roots is selected for singular formation, we find a result which shows epenthesis. The particular examples in (23) are realized as *sykkel*, *adel*, *hinder*, *orden*. (For discussion of Norwegian quantity, including the gemination of the [k] in *sykkel*, cf. Rice (2006a).)

It is crucial for the present analysis that the nouns just given are indeed formed from the roots in (23) and do not have the schwa in their underlying forms. The argument that the root of the singular noun *sykkel* is /sykl/, without the schwa seen in the singular, builds first of all on the fact that other forms using the same root lack the schwa. The indefinite plural suffix is *+er* such that 'bikes' is expressed as *sykler*, and not **sykkeler*. The definite plural ending *+ene* gives *syklene*, not **sykkelene* and the nominal derivation meaning 'cyclist' is *syklist* and not **sykkelist*. Given this variation within the paradigm, we need either an explanation for the presence of the schwa in the singular or an explanation of its absence in the other forms.

A second point draws on the fact that there are words which preserve the schwa throughout the paradigm. The noun *kjøkken* 'kitchen' has the

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definite plural *kjøkkenene* and not **kjøknene*, to take just one example. A foray into the realm of productive morphology could lead us to label 'a person who designs kitchens' as a *kjøkkenist* but certainly not a **kjøknist*.

While the class including *kjøkken* is significantly smaller than the class including *sykkel*, it does includes all proper names with the relevant structure. So, several guys named *Mikkel* are the *Mikkeler* and not the **Mikler*. The small size of the class notwithstanding, it remains the case that there are words which do not lose the schwa in the plural forms. Hence, there are two different classes of nouns. The difference between them is masked in the singular, where both show a schwa between two consonants of rising sonority. However, the classes differ in other forms of the paradigm. The most straightforward way to represent this difference is to include the schwa of *kjøkken* in the root while leaving the schwa of *sykkel* out of the root. An analysis of *sykler* as having lost the schwa between the [k] and the [l] is therefore dispreferred to an analysis in which the schwa is inserted in the singular.

We have now argued that the roots in (23) undergo epenthesis to form the singular. What happens when these roots become verbs and we attempt to form the imperative? In a word, nothing. These are the cases for which no imperative is possible for the class of speakers under consideration.

Hence we see that we have the same phonological ill-formedness in two different classes – the singular and the imperative – and the grammar responds to these differently. In one case, the ill-formedness is repaired; in the other, it is not, and a gap instead emerges. In the approach we are advocating here, this situation is a consequence of a grammar with two MAX{CAT} constraints flanking a faithfulness constraint, as seen above in (21).

MAX{SG.} and MAX{IMP.} are the specific constraints used below to model this contrast between Norwegian nouns and verbs. These constraints flank DEP, which of course punishes epenthesis. In (24), we present a paradigm consisting of four morphological categories: singular (noun), plural (noun), infinitive (verb), and imperative (verb). The tableau is presented in this way not to make any particular argument about nouns and verbs being part of the same paradigm, but simply as a convenient way to demonstrate that one grammar can lead to a repair for the nouns and a gap for the verbs.

Since the singular (noun) and the imperative (verb) are both derived from the root by zero derivation, and since the root under consideration ends with a cluster with rising sonority, both the singular and the imperative will violate SONORITYSEQUENCING. Hence, a paradigm with a fully faithful candidate for each of these categories will incur two violations of the markedness constraint, as seen in (24a).

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(24) *Different solutions for the singular and the imperative*

		sykl {sg., pl., inf., imp.}	SONSEQ	MAX{SG.}	DEP	MAX{IMP.}
	a.	$sykl_{sg.}$, $sykler_{pl.}$ $sykle_{inf.}$, $sykl_{imp.}$	*!*			
	b.	$sykler_{pl.}$, $sykle_{inf.}$		*!		*
☞	c.	$sykkel_{sg.}$, $sykler_{pl.}$, $sykle_{inf.}$			*	*
	d.	$sykkel_{sg.}$, $sykler_{pl.}$ $sykle_{inf.}$, $sykkel_{imp.}$			**!	

Candidate (24b) improves on (24a) by eliminating both of the SONSEQ violations. This considerable improvement is achieved through the radical move of eliminating both of the offending members from the paradigm. In other words, for a paradigm which should express four categories, candidate (b) is particularly defective, lacking fully half of its intended membership. The cost of this move is violation of the two MAX{CAT} constraints, including the fatal violation of MAX{SG.}.

Candidate (24b) can also be improved upon by constructing a candidate which satisfies both SONSEQ and MAX{SG.}. Candidates (24c) and (24d) both achieve this state. They both show the effects of the ranking MAX{SG.} ≫ DEP, whereby expression of the singular with an unfaithful form showing epenthesis is preferred to its non-expression. Candidate (24c) also shows the effect of ranking DEP over MAX insofar as respect for faithfulness compels a gap for the imperative.

Candidate (24d) simply illustrates the consequences of disrespect for the latter ranking. When an unfaithful candidate showing epenthesis is offered for both the singular and the imperative, DEP will be violated twice. Given the grammar under consideration, a candidate paradigm incurring two DEP violations is less harmonic than a candidate incurring just one.

This demonstration illustrates that two MAX{CAT} constraints flanking a faithfulness constraint will give two different solutions for the same problem. One instance of a sonority sequencing problem – in the noun – is repaired with epenthesis, while another instance of the same problem – in the verb – is solved by leaving the form unuttered, i.e. it is solved with a gap.

4.2 *A prediction about two repairs*

The tableau in (24) illustrates a very specific prediction of the optimal gaps approach to absolute ungrammaticality, as sketched in §3 above (Rice 2005). By positing morpheme-specific constraints requiring the expression

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of particular categories, that approach predicts that the same phonological problem can be solved in different ways in different morphological categories. The prediction, in fact, is even more specific, an observation which is discussed in this section, shown to be too strong in §4.3, and fine-tuned to make a falsifiable prediction in §4.4.

If both the singular and the imperative are repaired, then the two relevant MAX{CAT} constraints both dominate some faithfulness constraint. For example, if the singular and the imperative both show epenthesis, then both constraints dominate DEP. If the ranking of DEP and MAX{IMP.} (24) were reversed, then candidate (d) would be optimal, as demonstrated in (25).

(25) *Epenthesis in both the singular and the imperative*

	sykl {sg., pl., inf., imp.}	SONSEQ	MAX{SG.}	MAX{IMP.}	DEP
a.	$sykl_{sg.}$, $sykler_{pl.}$ $sykle_{inf.}$, $sykl_{imp.}$	*!*			
b.	$sykler_{pl.}$, $sykle_{inf.}$		*!	*	
c.	$sykkel_{sg.}$, $sykler_{pl.}$ $sykle_{inf.}$,			*!	*
☞ d.	$sykkel_{sg.}$, $sykler_{pl.}$ $sykle_{inf.}$, $sykkel_{imp.}$				**

Because the ranking of faithfulness constraints with respect to one another is fixed for any one grammar, the relative ranking of faithfulness and MAX{CAT} suggests that there are only two possible solutions. A phonologically infelicitous result of a morphological process can either result in a gap – if faithfulness dominates MAX{CAT} – or it can result in the selection of an unfaithful candidate – when MAX{CAT} dominates faithfulness. The properties of the unfaithful candidate are predictable in the usual OT way from the grammar. Specifically, the unfaithful candidate which is selected as optimal is the one which violates the lowest-ranked relevant faithfulness constraint. ('Relevant' here refers to the constraint which leads to the satisfaction of the highly ranked markedness constraint.)

Our concern now is to consider the consequences of a grammar which includes two faithfulness constraints. Is there any ranking which could give two different non-gap solutions in two different morphological domains? In other words, what prediction does this approach make regarding a dialect in which the singular shows epenthesis, *sykkel*, and the imperative shows devoicing, *sykl̥*?

As a brief illustration, consider a situation like the one seen with the Norwegian imperatives, where the grammar includes not only DEP but also ID(VOI). ID(VOI) punishes candidates which show variation between the input and output values for the feature [voice]. In the case of the Norwegian

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imperatives, the constraint ID(VOI) is relevant when entertaining the possibility of a repair by devoicing the sonorant in the offending cluster. If the illustration above had used ID(VOI) instead of DEP, then the repair under consideration would not be the epenthesis seen in the singular *sykkel*, but rather devoicing, yielding *sykl̥*. With a ranking such as MAX{SG.} ≫ ID(VOI), we would expect a singular showing devoicing.

When the singular shows epenthesis, we have already established that the relevant sub-ranking is MAX{SG.} ≫ DEP. For an imperative showing devoicing, the relevant subranking would have to be MAX{IMP.} ≫ ID(VOI). These two arguments give us an overall partial ranking as in (26).

(26) *Partial ranking* of MAX{CAT} *and two faithfulness constraints*
MAX{SG.}, MAX{IMP.} ≫ DEP, ID(VOI)

A complete analysis of course entails an attempt to complete this ranking, including a ranking of DEP and ID(VOI) with respect to one another. In the case under consideration, we are led to a paradox. In particular, a singular which shows epenthesis and not devoicing requires the ranking in (27).

(27) *Ranking of faithfulness for the singular*
MAX{SG.} ≫ ID(VOI) ≫ DEP

Only this ranking can give insertion as a strategy for beating both the fully faithful candidate and a candidate which violates the other faithfulness constraint.

(28) *Optimizing epenthesis in the singular*

	sykl {sg.}	SONSEQ	MAX{SG.}	ID(VOI)	DEP
a.	$sykl_{sg.}$	*!			
b.	$sykl_{sg.}$			*!	
☞ c.	$sykkel_{sg.}$				*

Because we consider only a single member of a paradigm in (28), we do not include as a candidate the non-expression of the singular, which obviously would violate MAX{SG.} and therefore be less harmonic than candidate (c).

A different ranking of the faithfulness constraints is required to get devoicing in the imperative. Specifically, the two faithfulness constraints must have the opposite ranking, as in (29).

(29) *Ranking of faithfulness for the imperative*
MAX{IMP.} ≫ DEP ≫ ID(VOI)

The ranking in (29) is necessary to defeat the candidacy of both the fully faithful candidate and a candidate showing epenthesis, as seen in (30).

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(30) *Optimizing devoicing in the imperative*

		sykl {imp.}	SONSEQ	MAX{IMP.}	DEP	ID(VOI)
	a.	$sykl_{sg.}$	*!			
☞	b.	$sykl_{sg.}$				*
	c.	$sykkel_{sg.}$			*!	

The tableaux in (28) and (30) show a ranking paradox: the analysis of the singular requires that ID(VOI) dominate DEP, while the analysis of the imperative requires the reverse ranking. These requirements cannot both be satisfied in a single grammar.

The demonstration of this ranking paradox reveals a specific prediction of the model under consideration. In particular, the optimal gaps model predicts that there are exactly two possible results in a "*same problem, different solutions*" situation, i.e. a situation in which two different morphological processes are thwarted by the same phonological well-formedness requirement. When a language shows this kind of situation, one possibility which the optimal gaps model predicts is that both forms will be repaired in the same way. The faithfulness constraints in the grammar have one constant ranking, and that ranking will lead to the optimization of exactly one 'repair'. The only exception to this – the second possibility – is when one of the categories is left unexpressed. In other words, if there are different solutions to the same problem, then one of the solutions must be a gap. There is no single ranking available for the four constraints given in (26) which will result in the selection of the same candidates as seen in (28) and (30).

With this line of reasoning, we can claim that the optimal gaps model predicts that the same problem cannot be resolved with two different 'repairs'. Using the illustration above, we are predicting that the sonority sequencing problem faced by singulars and imperatives cannot be resolved with epenthesis for one of them and devoicing for the other.

This is a claim which must be tested against the data. And, as is clear from the data offered in Rice (2003) on dialect variation in the realization of imperatives, as alluded to above, this claim is false, and the prediction is therefore too strong. There are in fact dialects in which the singular is realized with one kind of unfaithfulness – namely, epenthesis – while the imperative is realized with another kind – such as devoicing or deletion of the sonorant.

4.3 *Different repairs*

All varieties of Norwegian show epenthesis in the singular. Most speakers have a gap for the imperative, such that they circumlocute to construct a phrase with a similar meaning, usually one which invokes the infinitive.

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Other speakers use morphological syncretism, expressing the imperative with the infinitive.

Still other speakers employ phonological solutions for the stems with final clusters of rising sonority. As discussed in Rice (2003), strategies include devoicing the sonorant for those words in which the cluster begins with a voiceless obstruent. The root /sykl/, for example, can have [syk̥l̥] as its imperative. Another solution is to make the sonorant syllabic. Yet another solution – previously undocumented, but attested in the speech of an informant born in 1976 in Øverbygd in Måselv – is to delete the sonorant. This speaker provides data such as those seen in (31) as possible forms, existing alongside various circumlocutions.

(31) *Imperatives repaired by deletion*

(a) Åp vinduet!
open window.the
'Open the window!' root: /åpn/

(b) Klat ned fra hylla!
Climb down from shelf.the
'Climb down from the shelf!' root: /klatr/

(c) Stemp billetten!
stamp ticket.the
'Stamp the ticket!' root: /stempl/

(d) Syk nå fortere!
bike now faster
'Bike faster now!' root: /sykl/

Above, we considered the possibility of optimizing epenthesis in the singular and devoicing in the imperative. A parallel challenge will arise with the dialect in (31), which shows epenthesis in the singular and deletion in the imperative – where deletion of course would be modeled as earning a violation of MAX instead of ID(VOI). No single ranking of the constraints under consideration will be able to model both of these cases. Therefore, for Norwegian, a model of the resolution of the same conflict with two different repairs must include different grammars for nouns and for verbs. To formalize this, we pursue a model based on the insights of Smith (2001).

4.4 *Category-specific faithfulness constraints*

Phonological processes do not apply to the same degree in every phonological or morphological environment in a language. Neutralizations are more common, for example, in codas or in unstressed syllables or in affixes – all defined as weak positions – than they are in onsets or in stressed syllables or in roots – strong positions. Important discussion and references appear in Beckman (1998) under the label *positional faithfulness*. This concept has recently been deployed in the study of the phonological behavior of

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nouns (Smith 2001). Smith's hypothesis is that nouns behave as a kind of strong position. In Beckman's work, such hypotheses lead to the proposal that position-specific faithfulness constraints are part of the grammar. Smith carefully motivates a parallel proposal, namely noun-specific faithfulness constraints.

By incorporating Smith's proposal into the the paradigm-based model of gaps and repairs advocated here, the appropriate restrictions are achieved. Speakers who produce two different repairs for the same problem, as with the data seen in §4.3, show the common situation of having different phonologies for different morphological categories, which will be modeled here with category-specific faithfulness constraints.

We are now able to model the grammar of speakers who use epenthesis as a strategy for avoiding a SonSeq violation in the singular, but who use either deletion or devoicing in the imperative. Such a grammar is illustrated in (32).

(32) *Modeling two different repairs*

	sykl {sg., pl., inf., imp.}	Id(voi)$_N$	Dep$_N$	Dep	Id(voi)
a.	sykl$_{sg.}$, sykler$_{pl.}$ sykle$_{inf.}$, sykl$_{imp.}$	*!			**
b.	sykkel$_{sg.}$, sykler$_{pl.}$ sykle$_{inf.}$, sykkel$_{imp.}$		*	**!	
c.	sykl$_{sg.}$, sykler$_{pl.}$ sykle$_{inf.}$, sykkel$_{imp.}$	*!		*	*
☞ d.	sykkel$_{sg.}$, sykler$_{pl.}$ sykle$_{inf.}$, sykl$_{imp.}$		*	*	*

The two general faithfulness constraints are joined here by two noun-specific faithfulness constraints, Id(voi)$_N$ and Dep$_N$ following Smith's (2001) approach. These constraints respectively require identity of the voicing specification for segments in correspondence in nouns, and that nouns not show epenthesis. Our illustration of this strategy in (32) leaves aside a candidate paradigm with a fully faithful singular and imperative, which would be ruled out by the highly ranked SonSeq. It also leaves out candidates which fail to express either of the categories, since such candidates would be ruled out by the Max{cat} constraints, which we have already established as dominating the faithfulness constraints, cf. (27) and (29).

With these restrictions in place, we consider four candidate paradigms in (32), which illustrate two possible repairs – epenthesis and devoicing – for two problematic loci in the paradigm – the singular and the imperative. To optimize (32d), it is crucial that Id(voi)$_N$ dominate Dep$_N$. In this way, (32a)

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and (32c), which both show devoicing in the singular, are eliminated on the basis of their violations of $\textsc{Id(voi)}_N$. Candidates (32b) and (32d) both show epenthesis in the singular form of the noun, and are thereby left undistinguished by $\textsc{Dep}_N$, which they both violate. Therefore $\textsc{Dep}_N$ could appear anywhere in the constraint hierarchy below $\textsc{Id(voi)}_N$. DEP distinguishes (32b) from (32d), favoring (32d), while ID(VOI) distinguishes them in favor of (32b). For this reason, the ranking DEP $\gg$ ID(VOI) is crucial. The grammar in (32) correctly returns as optimal a candidate paradigm in which the singular form of the noun shows epenthesis while the imperative shows devoicing.

4.5 *One repair per category*

We conclude this section by teasing out one further prediction of our analysis now that noun-specific faithfulness has been introduced. The possibility of having two different repairs has been realized by distinguishing the categories in which the repairs apply. The noun-specific faithfulness constraints essentially allow us to have a slightly different phonology for the nouns than we have for the verbs. This is where a new prediction lies, offering yet another claim about the nature of "*same problem, different solutions*" situations.

If we imagine a situation in which the same problem arises twice, but now with the added complication that both instances of the problem are in the same morphological class – noun or verb, for example – then we make a prediction that two different repairs will not be possible. To be slightly more specific, if two different forms of the verb both have sonority sequencing problems, it should be possible to leave a gap for one or both of them, and it should be possible to repair one of them. But, if both of them are repaired, then the repair must be the same. The model we develop above offers only one strategy for getting two different repairs, and that strategy crucially appeals to different word class categorization. Without the possibility of an appeal to such a difference, it will not be possible to model two different repairs.

We can test this prediction in Norwegian dialects not yet discussed here. The so-called apocope dialects found, for example, in parts of Trøndelag and Nordland do not use the usual schwa suffix on infinitives. Instead, the infinitive is identical to the root. For roots which have final clusters with rising sonority, the sonority sequency problem therefore arises for both the infinitive and the imperative.

These dialects do not leave the infinitive unuttered. They produce it with epenthesis, e.g. *å sykkel* 'to bike'. We claim that this schwa is epenthetic since it appears in no verbs lacking this phonological property, and is absent in other forms of the same verb, e.g. *sykla* 'biked'.

What are these speakers predicted to do with the imperative? There are only two choices. Either they must have a gap or they must show epenthesis.

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The model presented here has no way of capturing epenthesis in the infinitive and devoicing or deletion in the imperative.

We have investigated this empirical prediction in the behavior of several speakers of apocope dialects, and our prediction has thus far been borne out. Some speakers have a gap for the imperative, some have a repair. Those who repair the imperative all do it with epenthesis, yielding identical forms for the infinitive and the imperative.

Testing the prediction that there can be only one repair type in any one morphological category will require extensive study of many more cases, but the positive preliminary findings can be taken as further support for a theory which offers such a specific prediction.

5. Discussion and conclusion

The *optimal gaps* strategy of Rice (2005) is developed to account for apparent blockage of a morphological process by the phonology, a situation known as *ineffability* or *absolute ungrammaticality* (Pesetsky 1997, Legendre et al. 1998, Ackema & Neeleman 2000, Legendre 2001, Törkenczy 2002). The approach, with its extensions here, has a number of advantages over previous approaches.

The most significant of these is that this approach allows us to eliminate the null output – the successor of the null parse (McCarthy 2002, Prince & Smolensky 1993). Recall that the null parse represents a candidate which has undergone total deletion, represented in a tableau as a row in which there is no candidate, i.e. no phonological material to evaluate. Using the null output to model gaps also requires an explicit stipulation: this candidate violates exactly one constraint, namely MPARSE.

Another merit of the optimal gaps approach is the revelation of "*same problem, different solutions*" phenomena. Hand in hand with the introduction of constraints which require the expression of particular categories comes the possibility that different MAX{CAT} constraints can have different relationships to some particular faithfulness constraint. Given two different morphological domains in which one and the same markedness constraint is violated, the possibility of MAX{CAT} constraints flanking a faithfulness constraint suggests that the same problem in these two different domains can have different solutions. This particular merit is shared with *string-based correspondence theory*, in which McCarthy & Wolf (2005) use morpheme-specific MPARSE constraints to introduce the same formal possibility. (For an early glimmer of this idea, cf. Russell (1995).)

In the present paper, one case has been analyzed which illustrates the *same problem, different solutions* phenomenon. Specifically, a syllabification problem faced by certain roots in Norwegian is resolved by epenthesis in the nominal paradigm, while it results in a gap in the verbal paradigm.

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Our proposed analysis of these facts offers a single grammar which yields both of these different solutions.

This result leads to an empirical prediction, namely that when two instances of the same problem are repaired (rather than leaving one as a gap), both must be repaired with the same strategy. This prediction was shown to be too strong in certain varieties of Norwegian. The model was therefore enhanced to allow for faithfulness constraints applying only to nouns. This model, too, makes a prediction, but this time one which is more specific and currently tenable. In particular, the approach predicts that if there is a phonotactic problem in two different potential words (infintive, imperative, etc.) within the same category (verb, noun, etc.), they must be repaired in the same way. Violations of SonSeq in two different verbal categories are found in some varieties of Norwegian and no data has yet been discovered which challenges the claim that if both are repaired, then the repair must be the same.

There are at least two specific directions in which the project reported on here requires extension. First of all, there are inputs from the realm of derivational morphology which also seem to map onto no output. To the extent that the optimal gaps approach as presented here is limited to inflectional paradigms, the derivational cases require further study.

Secondly, and by way of conclusion, perhaps an even more fundamental concern deserves our attention. Leaving a gap in a paradigm instead of repairing a phonologically ill-formed output is a dramatic solution for a grammar to offer. The literature on gaps cited here, along with the present work, makes it clear that this option is indeed at times taken. As such it reveals something about grammar and places on any model the burden of facilitating a gap as a possible output.

For Optimality Theory, strategies for discharging this burden are being explored – cf. the papers in Rice (To appear) – and the success of such research is of crucial importance to the viability of the theory, given the core architectural properties of the theory discussed in §2 above. Nonetheless, we might like to go beyond the modeling of gaps, beyond the claim that 'nothing' is a synchronic fact. We might like to understand the diachronic appearance and disappearance of gaps in paradigms (cf. Albright (2003, To appear)). Why should a grammar optimize a situation in which some particular morphological category is inexpressible because of the phonological properties of a root? What extragrammatical factors are relevant for understanding this situation? Why is a gap the best we can do, when the grammar abounds in plausible repair strategies? The answers to these questions may yield some insight into the nature of gaps. We can hope that such answers will emerge from the discovery and careful study of additional cases, along with more exploration of the subtle behaviors of the speakers who produce them.

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REFERENCES

Ackema, P. & Neeleman, A. (2000). Absolute ungrammatically. In van der Dekkers, J., Leeuw, F. & van de Weijer, J. (eds.), *Optimality Theory: phonology, syntax, and acquisition*. Oxford: Oxford University Press. 279–301.

Albright, A. (2003). A quantitative study of Spanish paradigm gaps. In Garding, G. & Tsujimura, M. (eds.), *WCCFL* **22**: *Proceedings of the 22nd West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press. 1–14.

Albright, A. (to appear). Lexical and morphological conditioning of paradigm gaps. In Rice (ed.).

Becker, M. (2003). Lexical stratification of Hebrew – the disyllabic maximum. In Falk, Y. N. (ed.), *Proceedings of the Israeli Association for Theoretical Linguistics* 19. <http://micro5.mscc.huji.ac.il/english/IATL/19/>.

Beckman, J. (1998). *Positional faithfulness*. Ph.D. dissertation, University of Massahusetts, Amherst. [Published 1999 by Garland.]

Crowhurst, M. (2001). Coda conditions and *um* infixation in Toba Batak. *Lingua* **111**. 561–590.

Eliasson, S. (1975). On the issue of directionality. In Dahlstedt, K.-H. (ed.), *The Nordic languages and modern linguistics/2*. Stockholm: Almqvist & Wiksell. 421–445.

Fanselow, G. & Féry, C. (2002). Ineffability in grammar. In Fanselow, G. & Féry, C. (eds.), *Resolving conflicts in grammars: Optimality Theory in syntax, morphology, and phonology*. Hamburg: Helmut Buske Verlag. 265–307.

Golston, C. (1995). Syntax outranks phonology: evidence from Ancient Greek. *Phonology* **12**. 343–368.

Hetzron, R. (1975). Where the grammar fails. *Language* **51**. 859–872.

Inkelas, S. & Orgun, C. O. (1995). Level ordering and economy in the lexical phonology of Turkish. *Language* **71**. 763–793.

Ito, J. & Hankamer, J. (1989). Notes on monosyllabism in Turkish. In Ito, J. & Runner, J. (eds.), *Phonology at Santa Cruz*. Santa Cruz, CA: Linguistics Research Center. 61–69.

Iverson, G. (1981). Rules, constraints, and paradigmatic lacunae. *Glossa* **15**. 136–144.

Kager, R. (2000). Stem stress and peak correspondence in Dutch. In van der Dekkers, J., Leeuw, F. & van de Weijer, J. (eds.), *Optimality Theory: phonology, syntax, and acquisition*. Oxford: Oxford University Press. 121–150.

Klein, T. B. (2005). Infixation and segmental constraint effects: UM and IN in Tagalog, Chamorro, and Toba Batak. *Lingua* **115**. 959–996.

Kristoffersen, G. (1991). *Aspects of Norwegian syllable structure*. Ph.D. dissertation, University of Tromsø.

Legendre, G. (2001). An introduction to Optimality Theory in syntax. In Legendre, G., Grimshaw, J. & Vikner, S. (eds.), *Optimality-theoretic syntax*. Cambridge, MA: MIT Press. 1–27.

Legendre, G., Smolensky, P. & Wilson, C. (1998). When is less more? Faithfulness and minimal links in *wh*-chains. In Barbosa, P., Fox, D., Hagstrom, P., McGinnis, M. & Pesetsky, D. (eds.), *Is the best good enough? Optimality and competition in syntax*. Cambridge, MA: MIT Press. 249–289.

McCarthy, J. J. (2002). *A thematic guide to Optimality Theory*. Cambridge: Cambridge University Press.

McCarthy, J. J. (2003). OT constraints are categorical. *Phonology* **20**. 75–138.

McCarthy, J. J. (2005). Optimal paradigms. In Downing, L., Hall, T. & Raffelsiefen, R. (eds.), *Paradigms in phonological theory*. Oxford: Oxford University Press. 295–371.

McCarthy, J. J. & Wolf, M. (2005). Less than zero: correspondence and the null output. Ms., University of Massachusetts, Amherst. ROA 722. [Revised version in Rice (to appear).]

Nevins, A. & Vaux, B. (2003). Metalinguistic, shmetalinguistic: the phonology of *shm*-reduplication. In *Proceedings of the Chicago Linguistic Society* **39**. Chicago: Chicago Linguistic Society.

Orgun, C. O. & Sprouse, R. L. (1999). From MPARSE to CONTROL: deriving ungrammaticality. *Phonology* **16**. 191–224.

Papp, F. (1969). *A Magyar nyelv szóvégmutató szótára* [Reverse dictionary of Hungarian]. Budapest: Akadémiai Kiadó.

https://doi.org/10.1017/S0022226706004488 Published online by Cambridge University Press

Pesetsky, D. (1997). Optimality Theory and syntax: movement and pronunciation. In Archangeli, D. & Langendoen, D. T. (eds.), *Optimality Theory: an overview*. London: Blackwell Publishers. 134–170.
Prince, A. S. & Smolensky, P. (1993). Optimality Theory: constraint interaction in generative grammar. Technical Report #2, Rutgers University Center for Cognitive Science. ROA 537. [Published 2004 by Blackwell.]
Raffelsiefen, R. (2004). Absolute ill-formedness and other morphophonological effects. *Phonology* **21**. 91–142.
Raffelsiefen, R. (2005). Paradigm uniformity effects versus domain effects. In Downing, L., Hall, T. & Raffelsiefen, R. (eds.), *Paradigms in phonological theory*. Oxford: Oxford University Press. 372–454.
Rebrus, P. & Törkenczy, M. (to appear). Covert and overt defectiveness in paradigms. In Rice (ed.).
Rice, C. (2003). Dialectal variation in Norwegian imperatives. *Nordlyd* **31**. 372–384.
Rice, C. (2005). Optimal gaps in optimal paradigms. *Catalan Journal of Linguistics* **4**. 155–170. [Special issue, *Morphology in phonology*, edited by Maria-Rosa Lloret & Jesús Jiménez.]
Rice, C. (2006a). Norwegian stress and quantity: the implications of loanwords. *Lingua* **116**. 1171–1194.
Rice, C. (2006b). When nothing wins: gaps and repairs at the phonology–morphology interface. In Davis, C., Deal, A. R. & Zabbal, Y. (eds.), *NELS* **36**. Amherst, MA: GLSA Publications. 27–38. ROA 781.
Rice, C. (ed.) (to appear). *Modeling ungrammaticality in Optimality Theory*. London: Equinox.
Rice, C. & Svenonius, P. (1998). Prosodic V2 in Northern Norwegian. Ms., University of Tromsø.
Russell, K. (1995). Morphemes and candidates in Optimality Theory. ROA 44.
Smith, J. L. (2001). Lexical category and phonological contrast. In Kirchner, R., Pater, J. & Wikeley, W. (eds.), *Proceedings of the Workshop on the Lexicon in Phonetics and Phonology*. Edmonton: University of Alberta. 61–72.
Struijke, C. (2002), *Existential faithfulness: a study of reduplicative TETU, feature movement and dissimilation*, Ph.D. dissertation, University of Maryland.
Törkenczy, M. (2002). Absolute phonological ungrammaticality in output-biased phonology. In Kenesi, I. & Síptar, P. (eds.), *Approaches to Hungarian* **8**: *Papers from the Budapest Conference*. Budapest: Akadémiai Kiadó. 311–324.
Walker, R. & Feng, B. (2004). A ternary model of morphology–phonology correspondence. In Schmeiser, B., Chand, V., Kelleher, A. & Rodriguez, A. (eds.), *WCCFL* **23**: *Proceedings of the 23rd West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press. 773–786.

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