# The Emergence of the Comparatively Unmarked

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## 1 Introduction

Non-structure preserving phonological processes are defined by the emergence of a segment which is assumed to be absent from the lexical inventory of the language in question and, hence not contrastive.

A central tenet of Optimality Theory (OT; Prince & Smolensky 1993/2004, McCarthy & Prince 1993, 1995, 1999), the Richness of the Base Hypothesis (RotB; Prince & Smolensky 1993) states that linguistic patterns emerge solely as an effect of constraint rankings.

(1) Richness of the Base Hypothesis (Smolensky 1996:3)
The source of all systematic cross-linguistic variation is constraint reranking. In particular, the set of *inputs* to the grammars of all languages is the same. The grammatical inventories of a language are the *outputs* which emerge from the grammar when it is fed the universal set of all possible inputs.

OT constraints are constraints on surface representations. Hence, there is no direct means in OT to account for the systematic absence of certain segments in underlying representations, since there are no constraints operative on these representations. Ex hypothesi, a restrictive analysis has to exclude illicit structures from surfacing if they are fed into the grammar as inputs. Non-contrastiveness of a feature is analysed in OT as the ranking of the markedness constraint against this feature above the relevant faithfulness constraint, as indicated in (2)a. Non-contrastive segments can emerge in satisfaction of a specific structural constraint that ranks even higher (2)b.

(2) No contrast and non-structure-preserving phonology
a. *F ›› FAITH(F)
b. PHONO-CONSTRAINT ›› *F ›› FAITH(F)

Closer examination of such cases reveals that this view is oversimplifying and runs into problems. In this paper I demonstrate this by looking at glottal stop epenthesis in German and argue for a uniform analysis of non-structure preserving phonology in terms of Comparative Markedness (CM; McCarthy 2002, 2003).

A glottal stop is epenthesised in German at the left edge of words and of stress feet to provide an onset for otherwise onsetless syllables (Wiese 1996/2000, Alber 2001). Because of the predictability of the emergence of this segment it is generally thought to be not contrastive in German, i.e., not present in any underlying representation. In contrast to this, the glottal stop in Selayarese (Lombardi 2002), for example, is predictable in some instances, but not all. Morpho-phonological alternations give cues as to which glottal stops are lexical and which are epenthesised. Between homophonous vowels a glottal

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stop is epenthesised, as can be seen in column one and four of (3). As columns two and three show, not all initial glottal stops are epenthesised, because some disappear between distinct vowels (a) and some don't (b). The obvious conclusion is that the glottal stop in (3)a is epenthetic and those in (3)b are lexical.

(3) Selayarese

| | | | | |
|---|---|---|---|---|
| a. | ku-ʔ-uraŋi | ri-uraŋi | ku-inuŋi | ri-ʔ-inuŋi |
| | 'I accompany him' | 'you hon. accompany him' | 'I drink it' | 'you hon. drink it' |
| b. | taʔ-ataʔ | taʔ-enteŋ | taʔ-inuŋ | |
| | 'to be roofed' | 'to be erected' | 'to be drunk' | |

(Lombardi 2002, Mithun & Basri 1986)

In OT, both cases (i.e., German and Selayarese) could be analysed under the assumption that whatever markedness constraint is violated by output glottal stops is lowest ranked to prohibit other consonants from appearing as the epenthetic element, and faithfulness is ranked above these markedness constraints, while the markedness constraints that trigger epenthesis are ranked topmost (as proposed in Lombardi 2002). This is schematized in (4).

(4) PhonoCONSTRAINT ›› FAITHFULNESS ›› *Lab/Dors ›› *Cor ›› *Lar

The German pattern, however, is a challenge for this analysis. A glottal stop emerges only and exclusively if it is predictable. There are no lexical glottal stops in German, at least none that surface faithfully. The ranking in (4), however, predicts that there should be some unpredictable glottal stops in German. (5) shows the predictable loci of insertion as well as alternation data that show that the glottal stop is not lexical - compare 'chaotic' and 'chaos'. (6) shows potential loci for lexical glottal stops to occur in which we never find this segment in German. Other stops, i.e., *p*, *t*, *k* are found in these positions in German (except for *t* + *l* or *n* and any *ʃ* + *k* sequences in onsets; see Wiese 1996/2000 for more details).

(5) Glottal stop in German

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | [ˈʔeːkl] | Ekel | 'disgust' | b. | [ˈzaːən] | sahen | 'see' (past, -2, pl.) |
| | [kaˈʔoːtɪʃ] | chaotisch | 'chaotic' | | [ˈkaɔs] | Chaos | 'chaos' |
| | [teˈʔaːta] | Theater | 'theatre' | | [teaˈtʀaːlɪʃ] | theatralisch | 'showily' |
| | [ʔiˈdjoːt] | Idiot | 'idiot' | | | | |

(6) Where glottal stop does not occur in German

| | | | | | |
|---|---|---|---|---|---|
| a. | *ʔlam | *ʔnam | *ʃʔloːm | *tylʔə | *tylʔ |
| | *ʔʀam | *ʃʔaːl | *ʃʔʀoːm | *tyʔə | *tyʔ |
| b. | * [naˈʔoːtɪʃ] ~ | [ˈnaʔɔs] | | | |

OT analyses of epenthesis account for the emergence of the epenthetic segment in the crucial contexts, but they do not account for the absence of the same segment in other environments, as in the impossible forms in (6). Hence, the difference between the two types of epenthesis found in Selayarese and German, respectively, is not accounted for. Alber (2001) provides an excellent analysis of the German data that predicts the locus of epenthesis and even the range of regional variation we find, while Lombardi (2002) provides an explanation for the fact that it is the glottal stop and not some other consonant (or glide) that is found here.[1]

In this paper I fill the gap in the analysis of glottal stop in German by providing an analysis that excludes the forms in (6). In the following section, I show that this task is at least difficult with the markedness constraints standardly used in OT. I develop an analysis in terms of CM which excludes

[1] See as well Uffmann (in press) for an account of the quality of epenthetic consonants in different positions.

glottal stops from all positions except the attested epenthesis sites. As a side effect, the segment is also excluded from underlying representations (section 3). There are two advantages of this account: It adheres to the RotB by providing a maximally restrictive grammar and it is generalisable to non-structure preserving phonological patterns in general, as will be shown in section 4. Section 5 concludes.

## 2 A ranking paradox

A crucial problem for a more exhaustive account of the distribution of glottal stop is that of relative markedness. In German, we can regard the glottal stop as the least marked stop, because it is the epenthetic consonant (5), but we also have to regard it as marked in some way because of its extremely restricted distribution (6). The least marked stop has to be excluded from unprominent positions (codas and onsets of unstressed syllables) and from marked positions (codas and complex onsets).

For the glottal stop in German, the reasoning on contrastiveness would lead to the ranking in (2)a/(7)a. Another chain of reasoning as put forward by Lombardi (2002) provides us with a contradictive ranking for German: Glottal stop is the epenthetic consonant, hence it must be unmarked in comparison to unsuccessful competitors, as for example stops with an oral place specification (e.g., *p,t,k*). Since oral place specifications are contrastive in German, markedness constraints against these have to be outranked by faithfulness constraints protecting place of articulation (7)b.[2] There is no way these two rankings could be unified into one (7)c.

(7) a. *Laryngeal ›› FAITH(Place) ›› *Labial, *Dorsal ›› *Coronal
b. FAITH(Place) ›› *Labial, *Dorsal ›› *Coronal ›› *Laryngeal

c. a + b =


There are several potential ways out of the dilemma. One could assume positional markedness constraints which ban glottal stop from exactly the positions it does not occur in. This would include very specific constraints against an unmarked segment in unmarked positions, such as simple onsets of unstressed syllables, as well as constraints referring to complex onsets as well as codas. This would be a brute-force way to capture the data without any explanatory gain. Another possibility is to adopt ranking (7) and to invoke a specific version of DEP-IO restricted to segments with any of the oral places of articulation ($\text{DEP-IO}_{\text{LAB/DORS/COR}}$) and rank it on top of the hierarchy. In this case we explain the German pattern, but have to resort to other means in other cases of non-structure preserving phonological processes (such as the emergence of the velar nasal in Italian (see section 4) or the emergence of a coronal flap in varieties of English in which intervocalic coronal stops are flapped, epenthetic schwa in many languages (e.g., German), schwa as the result of unstressed syllable reduction (e.g., English) and many others.

In this paper, I show that CM gives us a uniform treatment of non-structure preserving phonology. As a side effect of this analysis, underlying representations can be predicted as much more economic than usually assumed in OT. The non-contrastive segments emergent in some phonological environments cannot be stored in underlying representations. Due to lack of space I concentrate on the analysis of the glottal stop in German and the dorsal nasal in Italian.

The absence of glottal stops in German from any other position but the loci of epenthesis is accounted for as the effect of a ranking of markedness constraints against 'old' structure above markedness constraints against 'new' structure. This ranking bans both alternating as well as non-

[2] In (7) the markedness constraints against place of articulation are ranked in the way this is done in Prince & Smolensky (1993/2004), Lombardi (2002). This might be replaced by a scale as in de Lacy (2002) or no ranking at all, since there is some evidence that labial or even dorsal might behave as the unmarked (see e.g., Hume & Tserdanelis 2002 on labial).

alternating glottal stops (the latter occur for example at the beginning of words) from underlying representations, since if they were present at this level and fed into the grammar as an input they would surface as something else.

## 3 ʔ Limited

CM was introduced to account for certain cases of opacity and what McCarthy calls 'grandfathering effects'. Since these phenomena are not particularly relevant here I refer the interested reader to the original sources. Section 3.1 introduces CM and 3.2 presents the analysis of the glottal stop pattern.

### *3.1 Comparative markedness*

In CM, every markedness constraint is split into two. One instantiation is violated by marked structure in a given output candidate that was present in the underlying representation, or, for that matter, in the Fully Faithful Candidate (FFC, I will come back to this construct shortly). This kind of markedness constraint is labelled 'old markedness' ($_{O}$M). The other type of markedness is violated by marked structure in a given output candidate that was not present in the FFC, correspondingly labelled 'new markedness' ($_{N}$M).

The Fully Faithful Candidate is a candidate that is an exact match of the input, it is the candidate which has no violation of any faithfulness constraint (and is therefore "fully faithful"). The candidate can be fully prosodified though to be a possible output form, since prosodic structure is generally not assumed to be part of the input (with the exception of lexical stress).

In this theory of markedness the markedness constraints have to have access to the FFC, that is, a form that is not an actual output representation (only a potential one) and hence take up some of the properties of faithfulness constraints. Nevertheless, we still need faithfulness to interact with these markedness constraints. I illustrate this kind of constraints with markedness on place of articulation of obstruents. Assume a fairly broad markedness constraint against consonantal place of articulation, *PLACE.

(8) Old and New Markedness

a. $_{O}$*PLACE Assign a violation mark for each consonantal place of articulation in the output that is present in the FFC.

b. $_{N}$*PLACE Assign a violation mark for each consonantal place of articulation in the output that is *not* present in the FFC.

Now assume we have a stop specified as labial in the input. Accordingly, the FFC will be specified as labial as well.

(9) Comparative markedness constraint satisfaction and violation

| | /p/ FFC: p | $_{O}$*PLACE | $_{N}$*PLACE |
|---|---|---|---|
| a. | p | * | |
| b. | k | | * |
| c. | ∅ | | |

Under the assumption of full specification of surface forms, an underspecified input will be filled with a new feature in all output candidates and violate $_{N}$*PLACE. Thus, for a Comparative Markedness account of the glottal stop facts to work the glottal stop has to be specified for place, as in Lombardi (2002).

With a ranking in which Old Markedness outranks faithfulness and New Markedness, the unfaithful candidate will always win, and, any surface structure that violates the Old Markedness

constraint cannot be stored in underlying representations, since a faithful input-output mapping is impossible.[3] I will come back to this shortly.

(10) Ranking old markedness above new markedness

| | /p/ FFC: p | $_{O}$*LAB | MAXIO | $_{N}$*PLACE |
|---|---|---|---|---|
| a. | p | *! | | |
| ☞ b. | k | | | * |
| c. | ∅ | | *! | |

McCarthy (2002) discusses a case which is structurally quite similar to the pattern we are dealing with here. In Sanskrit, short [e] does not occur and long [eː] is always derived from sequences of /a+i/. This can bee seen from alternations in some cases, but not all, since there are instances of [eː] that are not the result of merger of tautomorphemic /a/ and /i/.

(11) Coalescence in Sanskrit

| | | | | | |
|---|---|---|---|---|---|
| /a+i/ | → | eː | | | |
| | | /ca$_1$ + i$_2$ha | → | ceː$_{1,2}$ha | 'and here' |
| /a+u/ | → | oː | | | |
| | | /ca$_1$ + u$_2$ktam | → | coː$_{1,2}$ktam | 'and said' |

To analyse the coalescence, Identity constraints on vowel height have to outrank the markedness constraint against the mid front vowel, but to capture the generalisation in OT that underlying mid front vowels do not exist we need the markedness constraint against [e] *MID to rank higher than faithfulness. This assures that all hypothetical underlying /e/s are mapped to something else on the surface. McCarthy resolves the paradox by splitting up *MID into one against old and one against new mid vowels. The markedness constraint against old, i.e., lexical mid vowels can be ranked high, banning all lexical mid vowels from surfacing faithfully, while the constraint against new, i.e., derived mid vowels has to be ranked low in Sanskrit. On the top of the hierarchy we find a constraint against diphthongs, *DIPH. McCarthy's analysis is reproduced, omitting some irrelevant detail, in tableau (12).

(12) Sanskrit[4]

| | /e/ | *DIPH | $_{O}$*MID | IDENT | $_{N}$*MID |
|---|---|---|---|---|---|
| a. | e | | *! | | |
| ☞ b. | i | | | * | |
| ☞ c. | a | | | * | |
| | /a$_1$ + i$_2$/ | | | | |
| d. | a$_1$i$_2$ | *! | | | |
| ☞ e. | eː$_{1,2}$ | | | | * |
| f. | iː $_{1,2}$ | | | *! | |

In the following paragraphs I apply the same machinery to the German pattern.

[3] Underlying representations are traditionally assumed to be determined by Lexicon Optimization (LO) in OT (Prince & Smolensky 1993, Inkelas 1994). For criticism of LO see Harrison & Kaun (2000, 2001), McCarthy (2006), Krämer (2006), Nevins & Vaux (to appear).

[4] In a later paper, McCarthy (2006) picks up the Sanskrit case again and deals with it without comparative markedness. In Sanskrit, this might be possible, if you assume the ranking of *MID above faithfulness to height features and all other relevant faithfulness constraints even higher than the markedness constraint against diphthongs. Closer investigation of the Sanskrit data and analysis has to show, however, whether such an analysis is as restrictive as it should be according to the RotB. I leave this to future work for reasons of space.

### *3.2 The comparative markedness of glottal stops in German*

In German, coronals are no good epenthetic consonants, and labials, dorsals and coronals are contrastive. For these we do not need to divide the markedness constraints. But for glottal stops we can say that they should not surface faithfully if in the input, hence we have a reason to assume that $_{O}$*LAR outranks $_{N}$*LAR.[5] We can rank faithfulness to place of articulation between the two constraints. This yields the grammar illustrated for the evaluation of glottal stop in the input in (13).

(13) Hypothetical input

| | /ʃʔʀoːʔ/ | $_{O}$*LAR | MAXIO | IDENT(PLACE) | $_{N}$*LAR |
|---|---|---|---|---|---|
| a. | ʃʔʀoːʔ | *!* | | | |
| ☞ b. | ʃtʀoːt | | | ** | |
| c. | ʃʀoː | | *!* | | |

As one can see in (13), a hypothetical underlying glottal stop can never surface. The winning candidate is not an attested word of German, but it is a *possible* word, unlike candidate (a). This does not mean, of course, that surface coronal stops in comparable positions (such as in *Stroh* 'straw', *Tüte* 'bag', *tot* 'dead' etc.) are stored as glottal stops underlyingly. Also, the ranking of MAX-IO with respect to IDENT(place) which determines the choice of the substitution candidate (b) over the deletion candidate (c) is not crucial here, it might as well be the other way round. The point is: A glottal stop in the input would be mapped to something else. The mirror image conclusion that this "something else" at the surface (for example every surface [t]) is always stored as a glottal stop is not implied.

I proceed to show how this grammar selects a candidate with an epenthetic consonant. The grammar in (14) has the constraint ONSET added, which discards onsetless output candidates from vowel-initial inputs.

(14) Epenthesis

| | /ekl/ | $_{O}$*LAR | ONSET | IDENT(PLACE) | $_{N}$*LAR |
|---|---|---|---|---|---|
| a. | ˈeːkl | | *! | | |
| ☞ b. | ˈʔeːkl | | | | * |

However, glottal stop competes with the other stops for the status of epenthetic consonant. Markedness constraints against labial, coronal and dorsal should rank below faithfulness to place, since these features are distinctive and they should rank above $_{N}$*LAR., because these places of articulation are more marked than glottal in the sense that the chosen inserted segment is glottal. The latter ranking yields an inserted glottal stop as the least marked segment. Tableau (15) shows how this grammar prefers glottal stops over epenthetic consonants with other places of articulation.

(15) Choosing the right epenthetic consonant

| | /ekl/ | ONSET | $_{O}$*LAR | IDENT(PLACE) | *LAB/DORS/COR | $_{N}$*LAR |
|---|---|---|---|---|---|---|
| a. | ˈeːkl | *! | | | | |
| b. | ˈteːkl | | | | ***! | |
| c. | ˈpeːkl | | | | ***! | |
| d. | ˈkeːkl | | | | ***! | |
| ☞ e. | ˈʔeːkl | | | | ** | * |

[5] I use a simplified version of a markedness constraint against glottal stops, abstracting away from the distinctions made by Lombardi (2002), since pharyngeals are irrelevant in German. Also, the question whether the defining feature of a glottal stop is actually [-cont] or [constricted glottis] or a place feature is beyond the scope of this paper. Analysing the glottal stop as one of these options, though, would open the door for underspecification of the place feature and for retaining a universal markedness scale of consonantal place features with glottal/laryngeal as the unmarked place (in the sense of unspecified).

With this ranking, the emergent non-alternating glottal stops in German cannot be stored in underlying representations. If they were they would be mapped to diverging surface segments to avoid the violation of $_{O}$*LAR, as shown in (13). Thus, a form like [ˈʔeːkl] cannot be stored as /ʔeːkl/, since this underlying form as an input would not result in the output [ˈʔeːkl] but rather [ˈteːkl]. The latter is not phonotactically bad, it is simply the wrong output for the intended form. This unfaithful map, however, crucially depends on high ranking of MAXIO in (13). For the current analysis it does not make a difference whether a hypothetical input /ʃʔʀoːʔ/ is mapped to [ʃtʀoːt] or [ʃʀoː] or a null output. As can be seen from the [ˈʔeːkl] example, there is a small difference: simple deletion of a glottal stop in the input is not an option since this would lead to a surface contrast between glottal stop-initial words and vowel-initial words, with the former deriving from vowel-initial inputs and the latter from glottal stop-initial inputs, which is not the case.[6]

## 4 Extension: Structure preservation

The ranking of old markedness above new markedness can be applied to a wider range of data. Similar cases in which a phonological process produces a segment that is generally assumed to be absent from the underlying inventory of a language are legion. For reasons of space I concentrate on a brief discussion of one relatively straightforward example, the emergence of the dorsal nasal in Italian.

In Standard Italian, [ŋ] emerges only as the result of place assimilation to the following obstruent. To account for the fact that Italian does not allow the dorsal nasal in the lexicon, we can assume that the $_{O}$markedness constraint against this segment, *$_{O}$[Dors,Nas], outranks faithfulness. This markedness constraint is dominated by another constraint that does not allow place specification in coda position, shorthand CODACOND (cf. Itô 1988). (16) shows how a dorsal nasal in the input is mapped to an unfaithful output.

(16) *[ŋ]okko

| | /ŋokko/ | FAITH(NAS) | CODACOND | *$_{O}$[Dors,Nas] | FAITH(PLACE) | *$_{N}$[Dors,Nas] |
|---|---|---|---|---|---|---|
| a. | ŋokko | | | *! | | |
| ☞ b. | ɲokko | | | | * | |
| c. | gokko | *! | | | * | |

The emergence of the dorsal nasal before a dorsal consonant is possible because of the low ranking of *$_{N}$[Dors,Nas]. This is illustrated in (17). With this simple grammar we exclude the dorsal nasal everywhere except in the assimilation context, and this is all that is needed.

(17)

| | /tʃimkʷe/ | FAITH(NAS) | CODACOND | *$_{O}$[ŋ] | FAITH(PLACE) | *$_{N}$[ŋ] |
|---|---|---|---|---|---|---|
| a. | tʃimkʷe | | *! | | | |
| b. | tʃinkʷe | | *! | | * | |
| ☞ c. | tʃiŋkʷe | | | | * | * |
| d. | tʃikkʷe | *! | | | | |

[6] In colloquial German, there is one more context in which glottal stop can occur. If a voiceless stop is followed by a syllabic sonorant it is realised as a glottal stop. The underlying place feature of the stop is realised on the following nasal if the nucleus is filled by a nasal, as shown in (i).

i. [ʀatə] [ʀaʔn] Ratte / Ratten 'rat/s' [laʔm] Lappen 'cloth'
[hakə] [haʔŋ] Hacke / Hacken 'hoe/s' [haːʔŋ] Haken 'hook'

Sketching an analysis in which the glottal stop is the optimal output we have to rank a triggering constraint (shorthand DEBUCC) and MAXIO with respect to the other constraints considered so far, in particular *$_{N}$LAR and IDENTITY(place). To get any neutralisation effect at all DEBUCC has to outrank the constraint against new glottal stops and the faithfulness constraints guarding consonantal place features. For a full discussion see the extended version of this paper.

In conclusion, the general ranking schema for the emergence of non-contrastive segments as a result of phonological processes given in (2) is not only too simplistic, it does not stand scrutiny and should be replaced with a more appropriate formula. In derivational phonological theory the insight that some surface segments are not part of the lexicon was captured by the principle of structure preservation (Kiparsky 1982), which holds that structure preservation is a restriction on the lexical level of phonology, and, hence, all phonological processes that produce non-contrastive structure have to be post-lexical (and exceptionless).[7] OT, due to its theoretical architecture, cannot make this reference to distinct levels of phonological analysis (with the exception of derivational/Stratal OT; Rubach 1997 et seq., Kiparsky 2000, Bermúdez-Otero in press). However, comparative markedness gives us another surprising result. If you compare the schematic rankings given by McCarthy for Counterfeeding Opacity and Derived Environment Effects, (18)a,b with the ranking we need to account for the Sanskrit, the German and the Italian patterns (18)c it turns out that non-structure preserving phonology corresponds to the schematic ranking of counterfeeding opacity.

(18) Schematic rankings

| | |
|---|---|
| a. Counterfeeding opacity: | $_{O}$M ›› FAITH ›› $_{N}$M |
| b. DEE: | $_{N}$M ›› FAITH ›› $_{O}$M |
| c. Sanskrit/German/Italian ranking | $_{O}$M ›› FAITH ›› $_{N}$M |
| d. Structure preservation: | $_{N}$M, $_{O}$M ›› FAITH |
| e. Structure 'innovation': | $_{O}$M ›› FAITH ›› $_{N}$M |

However, this comparison is misleading, since it ignores which role the constraints play in the analysis. In the rankings (18)a,b, the schematic $_{O}$M and $_{N}$M refer to the constraints that actually *trigger* a phonological process, determining where a process applies or fails to do so, that is, counterfeeding opacity applies only in non-derived structures, while DEEs do not apply to phonologically or morphologically underived/unaltered structures. In the cases discussed in this paper, on the other hand, the $_{O}$M/$_{N}$M distinction is crucial among the constraints that select the resulting segment. In the latter cases, the triggering constraints (ONSET in German, *DIPH in Sanskrit and CODACOND in Italian) are not divided into $_{O}$ and $_{N}$ variants. They apply across the board, ignoring the $_{O}$/$_{N}$ dichotomy.

To derive a generalisation such as structure preservation, we have to consider this latter factor as well: unconditional application of a phonological process together with an $_{O}$M ›› $_{N}$M ranking of markedness constraints selecting the result of the process amount to Kiparsky's original insight.

What is predicted by the reverse ranking possibility, corresponding to the schematic ranking (18)b, i.e., faithfulness sandwiched between high ranking $_{N}$M and low $_{O}$M determining the result ($_{N}$M ›› FAITH ›› $_{O}$M)? This ranking generates a contrastive segment that can never be the result of a phonological process. The non-high rounded vowels in Turkish vowel harmony might be an example for such a ranking. In Turkish, high affix vowels agree with the preceding vowel in backness and roundness. The non-high affix vowels agree in backness only, never changing to [ø] or [o] when preceded by a round vowel (Clements & Sezer 1981). Thus, non-high rounded vowels occur contrastively but never as the result of vowel harmony.

## 5 Conclusion

Segments or feature constellations that are predictable in all occurrences have traditionally been regarded as absent from the lexicon of a language. In a framework that has access to both the surface level and the underlying level of representation this can be achieved by constraints on the lexicon itself. With the Richness of the Base Hypothesis as one of the fundamental assumptions of Optimality Theory, this framework does not have this option. Since ex hypothesi this option is not available the evaluation metric for an analysis lies in the consideration of all conceivable inputs to a grammar and the exclusion of these as licit outputs if they do not conform to the surface patterns of the language in

[7] This claim, i.e., that lexical phonology is structure preserving while post-lexical phonology can be non-structure preserving was shown to be untenable by Harris (1987, 1990), who discusses several allophonic processes that have to apply at the lexical level to be accounted for in Lexical Phonology.

question. For output structures that are completely predictable in their quality and in the environment in which they occur, accordingly, an analysis has to exclude these structures in all other environments rather than just predict their emergence in a limited set of positions. From this perspective, predictability has to be regarded as an effect of active neutralisation. If the input that is illicit as an output is considered it has to be mapped to some other structure. Analyses of epenthesis in OT have not captured this aspect of the pattern so far. If the epenthetic segment is part of the inventory this is not an issue, but if, as with German glottal stop epenthesis, the pattern is not structure preserving this has to be accounted for. Otherwise, the emergent lexical gap would have to be regarded as a historical accident.

As we have seen in this paper, Comparative Markedness gives us a tool to account for this aspect of German epenthesis and furthermore enables us to develop a unified theory of the emergence of non-contrastive segments in Optimality Theory.

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