Coronal Underspecification and Optimality Theory

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Abstract
In this paper I address the issue of the role of underspecification of input representations in Optimality Theory (Prince and Smolensky (1993), McCarthy and Prince (1993a)). The arguments against the need for underspecification in OT are presented and shown to be unconvincing in the face of typical patterns of place assimilation in consonants. The only full-specification OT accounts put forth appeal to a stipulated preferential treatment of marked elements under Faithfulness. I present an alternate analysis of place assimilation assuming underspecified representations and demonstrate how this analysis allows Faithfulness and constraints on markedness to apply without stipulations regarding constraint characterization and ranking.

1. Introduction
The focus of this paper is the role of underspecified input representations in Optimality Theory (Prince and Smolensky (1993), McCarthy and Prince (1993a)). Recent work in OT has argued that input representations are largely irrelevant since a hierarchy of universal constraints on output representations alone will predict the surface realization of a form (Smolensky (1993), Ito, Mester, and Padgett (1995), Kiparsky (1994)). However, the theory faces some difficulty in accounting for universal place assimilation facts. These same facts are accounted for elegantly in an underspecification analysis. I argue that the implementation of underspecified inputs allows assimilation patterns to be accounted for in a simple and non-stipulative manner.

The paper is structured as follows. First I outline some of the motivations for assuming underspecified representations. Next I present the arguments against underspecification in Optimality Theory and argue that, while the cases discussed may not require underspecification, underspecification has not been shown to be incompatible with the theory. Then, I present an analysis in which underspecification of the input proves to be the most elegant explanation for the asymmetrical patterning of segments. My analysis rests crucially on the interaction of Faithfulness constraints with the input representation. Finally, I address some of the criticisms from McCarthy and Taub (1992) of underspecification within a derivational model and argue that, within a non-derivational model such as OT, these problems are alleviated.

* I would like to thank the members of the phonology project in the Department of Linguistics at the University of Toronto as well as the participants at the Coronals Workshop at the University of Toronto (May 23, 1996) for their helpful comments and suggestions. Those from Keren Rice and Greg Lamontagne are particularly acknowledged. All errors, of course, are my own. This work was supported by a SSHRCC grant (410-92-0885) to K. Rice and B.E. Dresher.

1 In this paper I do not discuss any contribution to the discussion that may be made by the assumption of Correspondence Theory (McCarthy and Prince 1995). It seems likely that the claims made regarding the irrelevance of Underspecification Theory to OT still hold for Correspondence-based OT, and that the arguments for and against UT in OT presented in this paper are easily carried over into a CT approach. However, the possibility that CT may provide additional motivation for either side of the issue needs to be explored.
2. Underspecification: an overview

In a theory of underspecification, all redundant or predictable information is left out of the underlying representation. The phonological component supplies this missing information by means of two types of processes. The first type fills in contextually determined properties from UR. For example, in languages where stress placement is predictable, it is left out of the UR and a rule such as stress the last vowel in the word fills in the information about stress. The second type of process fills in missing information which is predictable regardless of context. For example, sonorants are predictably voiced and therefore voice specification for sonorants may be left out of the UR and supplied by the phonology before phonetic interpretation. These types of processes are called redundancy rules (Kiparsky 1985, and see Steriade 1995 for comprehensive references).

The effects of underspecification may be seen in languages in which contextual phonological rules precede redundancy rules. Since voicing in sonorants is predictable and therefore left out of the underlying representation of sonorant segments, prior to the application of the redundancy rule filling in the predictable voicing on sonorants, a rule which refers to voiced elements should not be able to refer to sonorants. Such a case is found in Russian where a voicing assimilation rule ignores the voicing of sonorants (Kiparsky 1985). Sonorants, which are redundantly voiced and carry no specification for voice underlyingly, get marked [+voice] after the application of the voicing assimilation rule, and therefore do not participate.

One of the main arguments in favour of underspecification is that it serves to illuminate the relationship between unmarked elements and their special status with respect to phonological processes. Some phonological processes treat particular segments differently from other segments in the inventory. For example, the exceptional behaviour of coronal consonants cross-linguistically has received much attention (e.g. Paradis and Prunet 1991, Cho 1991, Avery and Rice 1989). What is striking about these exceptional elements is that they are universally unmarked segments. The asymmetrical treatment of unmarked elements falls out naturally from the assumption of underspecified representations. Since a particular segment in an inventory differs from other segments in that it lacks a particular feature \( \alpha \), it follows that such segments may respond differently to phonological processes making reference to \( \alpha \). In this section I will present some cases where unmarked (and underspecified) elements behave differently from other segments with respect to certain processes.

2.2 The Feature Coronal

Avery and Rice (1989) present evidence that Catalan nasals, laterals and stops are underspecified for the feature coronal based on asymmetries in assimilation patterns. In the data discussed, coronal nasals, laterals, and stops assimilate to the place of the following consonant. Labial and dorsal nasals and stops fail to undergo such assimilation in the same environment. In (1)-(3) I have presented the examples involving nasals (from pp.187-8).
(1) /n/

<table>
<thead>
<tr>
<th>Place</th>
<th>Example 1</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. unassimilated</td>
<td>so[n] amics</td>
<td>they are friends</td>
</tr>
<tr>
<td>b. labial</td>
<td>so[m] pocs</td>
<td>they are few</td>
</tr>
<tr>
<td>c. labiodental</td>
<td>so[m] felicó̞s</td>
<td>they are happy</td>
</tr>
<tr>
<td>d. dental</td>
<td>so[n] dos</td>
<td>they are two</td>
</tr>
<tr>
<td>e. alveolar</td>
<td>so[n] sincers</td>
<td>they are sincere</td>
</tr>
<tr>
<td>f. postalveolar</td>
<td>so[n] ris</td>
<td>they are rich</td>
</tr>
<tr>
<td>g. laminopalatal</td>
<td>so[n, 3]ermans</td>
<td>they are brothers</td>
</tr>
<tr>
<td>h. palatal</td>
<td>so[n ə]iures</td>
<td>they are free</td>
</tr>
<tr>
<td>i. velar</td>
<td>so[ŋ] grans</td>
<td>they are big</td>
</tr>
</tbody>
</table>

(2) /m/

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. so[m] amics</td>
<td>we are friends</td>
</tr>
<tr>
<td>b. so[m] pocs</td>
<td>we are few</td>
</tr>
<tr>
<td>c. so[m] felicó̞s</td>
<td>we are happy</td>
</tr>
<tr>
<td>d. so[m] dos</td>
<td>we are two</td>
</tr>
</tbody>
</table>

(3) /ŋ/

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ti[ŋ] pa</td>
<td>I have bread</td>
</tr>
</tbody>
</table>

(4) /ŋ/  

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. a[ŋ] felić̟</td>
<td>happy year</td>
</tr>
</tbody>
</table>

In (1), the final nasal of son surfaces as a coronal when preceding a vowel-initial word (a) or when preceding a coronal-initial word (d-f). When a labial-initial or dorsal-initial word follows, however, the final nasal shows up as a labial or dorsal respectively. In (2)-(4), we see that a final nasal which is labial, dorsal, or palatal does not assimilate to the place of a following consonant. Avery and Rice suggest that the unique patterning of the coronal nasal reflects a lack of place specification in the underlying representation of the segment. The segment can get a place specification in the phonology via spreading of place from a neighbouring consonant, or failing that, the feature coronal will be filled in by redundancy rules in the phonetic implementation component.

Avery and Rice also discuss a similar rule of nasal place assimilation in English. A nasal may optionally assimilate to the place of the initial consonant of a following word. They discuss examples involving the preposition in which I repeat in (5).

(5) labial       i[m] Brussels
labiodental    i[m] France
dental         i[n] there
alveolar       i[n] Toronto
velar          i[ŋ] Kingston

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2Avery and Rice note that the non-coronal nasals do assimilate within their own primary content nodes.
Parallel to the Catalan case, only coronal nasals seem to undergo this assimilation; labials do not assimilate to the place of a following coronal or dorsal segment. Again, this may be explained by assuming that the coronal nasal is unspecified for place in the underlying representation and that place is later filled in either by spreading or a redundancy rule.

In their discussion of other English facts, Avery and Rice claim that the underlying representation of coronal stops lack a specification for place. Instead, the underlying representation of /t/ has an empty place node. They note that in some dialects of English, /t/ may be realized as a glottal stop before a syllabic nasal, such as in the forms in (7), or in word-final position before a consonant-initial word, as in (8).

(7) bA?n "button"
bæ?n "batten"
ka?n "cotton"

(8) hI? ðə "hit the..."
kA? flaw٪ "cut flowers"

It is significant that /?/ surfaces as an alternate of /t/ but not of /p/ or /k/. This seems natural under the assumption that both /t/ and glottal stop lack a feature for place underlyingly. This alternation is a reflection of the optionality of the fill-in rule of the default feature coronal: when coronal is filled in, the segment is realized as [t], otherwise as [?].

Thus a representation-based account of these facts provides an elegant solution to the problem of the unique patterning of coronal consonants with respect to assimilation facts. If Optimality Theory does not make use of underspecified representations, how is the asymmetrical treatment of particular segments within an inventory accounted for? In the next section I address this question.

3. Optimality Theory:

3.1 Introduction

Proponents of Optimality Theory have argued that a program of underspecification is an unnecessary and even undesirable component of the theory (McCarthy and Prince (1993), Prince and Smolensky (1993), Smolensky (1993), Itó, Mester and Padgett (1995), Kiparsky (1994), McCarthy (1994)). In this theory, a set of universal constraints hold over output forms, and the degree of specification of input forms plays little if any role. This means that the correlations between markedness and phonological activity are unrelated to the specification of an input form, and instead these effects fall out from constraint interaction. In this section, I review the cases made against an underspecification program in OT, and show that, although some of the empirical ground covered by

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3In some dialects of English, all voiceless stops may surface as ? in certain contexts. However this more general process may be seen as debuccalization where the entire place node is delinked.
underspecification may be taken care of with a set of output constraints, certain facts are left unaccounted for.

3.2 Markedness and Defaults

Markedness effects in OT arise from a universally ranked set of constraints prohibiting marked elements (Prince and Smolensky (1993), McCarthy and Prince (1993), McCarthy (1993, 1994)). These constraints are of the form *α, *β, and their fixed ranking relative to one another is based on the same markedness considerations found in a theory of underspecification. If α is a more marked element than β, the ranking is *α >> *β. This means that a form including α incurs a greater violation than one containing β. An important principle at work is that all elements are marked to some degree but β is less marked (or more unmarked) than α. All else being equal, the less marked item will be preferred and a form containing β will be selected as optimal over one containing α.

In the majority of cases, all things will not be equal and other constraints such as faithfulness will interfere with the effects of the markedness constraints. For example, if α is part of the input, and a faithfulness constraint requiring input-output identity is ranked high, then α will be part of the output form regardless of its marked status. However, the markedness constraints will have an effect in cases where other constraints are not at issue, as in the case of epenthetic elements. If an epenthetic element is required, creating a violation of faithfulness in any case, the least marked element will be chosen for insertion. The least marked element is that which incurs a violation of the lowest-ranked markedness constraint. A tableau illustrating the effects of these markedness constraints will be given in (9).

The segmental markedness hierarchy of constraints thus ties together the universal popularity of certain segments as epenthetic and their unmarked status. For example, as frequently noted in the underspecification literature and in McCarthy (1994), placeless or coronal segments are typical epenthetic segments while labial and dorsal segments are unattested in epenthetic elements. This preference reflects the ranking of constraints concerning the markedness of place of articulation and a constraint requiring the specification of place for a segment (SEGHEAD). The markedness constraints prohibiting place specification are in a fixed ranking relationship reflecting the relative markedness of place features. *COR prohibits coronal place specification but since this place feature is less marked (and therefore more harmonic) than non-coronal place specifications, it is ranked below *-COR which prohibits non-coronal place specifications. The tableaux in (9) and (10) are repeated from McCarthy (1994).

(9) Bare Root node epenthes? /p/

<table>
<thead>
<tr>
<th>Candidates</th>
<th>*-COR</th>
<th>*COR</th>
<th>SEGHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. R t</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. (Rt, -Cor)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. (Rt, Cor)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

(10) Coronal consonant Eponenthes

<table>
<thead>
<tr>
<th>Candidates</th>
<th>SEGHEAD</th>
<th>*-COR</th>
<th>*COR</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. R t</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. (Rt, -Cor)</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. R t</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>
The tableau in (9) has SEGHEAD lowest-ranked, so the constraint set will select a placeless consonant as epenthetic: a consonant without place does not incur any violations of the constraints prohibiting place specifications. The tableau in (10) has SEGHEAD highest-ranked, so the successful candidate will inevitably have a place specification. This means that one of the two constraints on place (*-COR or *COR) will have to be violated. Since coronal is the least marked place feature, it is lower-ranked than non-coronals and it is the least offensive violation.

The universal ranking of *-COR »*COR will ensure that no labial or dorsal consonant will ever be epenthetic, since an epenthetic coronal will always be preferred. Thus, these markedness constraints provide an elegant means of explaining default specifications for segments. Notice that these markedness-type constraints can also be extended to other levels of the phonology. For example, in terms of prosodic structure, the least marked syllable is one which has an onset and no coda; the unmarked (and therefore preferred) iamb is a foot with a light syllable followed by a heavy syllable. If the grammar has a choice between the marked or unmarked structure, it will always select the unmarked one (all other things being equal). Thus, OT provides a unified treatment of markedness and defaults in a grammar.

3.3 The Irrelevance of Input Specifications

One of the main arguments for rejecting underspecification theories within OT is that it is an unnecessary complication of the theory, since the constraint system alone can account for apparent underspecification effects:

*Central to the optimality-theoretic enterprise is the hypothesis that explanation can be achieved through output constraints alone. Therefore, neither underspecification, nor anything else, can be meaningfully required of inputs.*

(Ito, Mester, and Padgett 1995: 588-9)

Ito, Mester, and Padgett (1995) examine one arena in which underspecification has played a key role: the behaviour of redundant features. They show that constraint interaction will select the correct output representation, even where there are several possible input representations.

Ito, Mester, and Padgett (henceforth IMP) address the issue of nasal voicing in Japanese and the complications it presents for a theory of underspecification. Like other sonorants, nasals are redundantly voiced and therefore may be expected to be inert with respect to triggering or blocking of phonological processes which refer to voicing. This expectation seems to be fulfilled in the interaction of Japanese Rendaku and Lyman's Law. Rendaku is the term for the voicing of the initial obstruent in the second member of a compound, as demonstrated in the examples in (11) (taken from IMP (1995: 574).

(11)

| a. ori + kami → origami |  | paper folding |
| b. oo + sumoo → oozumoo |  | grand sumo tournament |
| c. yama + tera → yamadera |  | mountain temple |

Rendaku is over-ridden by Lyman's Law, which prohibits more than one voiced obstruent per root. Therefore, where the second member of a compound already has a voiced obstruent, the initial-obstruent will not be voiced by Rendaku. Some examples (taken from IMP (1995: 575)) are given in (12).
Although phonetically voiced, sonorants do not behave like voiced segments with respect to Lyman's law. That is, Rendaku still applies when there is a sonorant in the second member of the compound. Thus, the m in the second morpheme in (11a) does not block the voicing of the initial obstruent.

This patterning of sonorants falls out naturally if it is assumed that sonorants do not have an underlying specification for voice. Instead, this is filled in by a redundancy rule ordered after the application of Rendaku and Lyman's Law. However, another constraint in Japanese phonology requires that nasals have a voice specification. This constraint ensures that all nasal-obstruent clusters are voiced. Some examples of this constraint at work are given in (13), taken from IMP (1995: 575).

It seems that the feature [voice] of the nasal is shared by (or spread to) the obstruent in these clusters. This in itself is not a problem for an underspecification account; the nasal-obstruent voicing constraint could hold after the application of the redundancy rule filling in voicing of nasals (as in Ito and Mester (1986)). The problem is that for the purposes of Rendaku and Lyman's Law, these clusters are treated as though they are voiced. If Rendaku and Lyman's Law apply before the redundancy rule inserting [voice], they should not be able to see the voicing on a cluster which results from the redundancy rule.

IMP argue that such a paradox does not arise in a non-derivational, constraint-based approach such as the OT analysis that they suggest. In this analysis, they exploit the relationship between feature redundancy and licensing in terms of antagonistic constraints. One constraint requires the presence of the redundant feature, while the other constraint requires proper licensing of features (License(Ø)). Conflict arises between these two constraints because of a restriction on licensing where a feature that is redundant (i.e. inherent) to a segment cannot be licensed by that segment. In the case of nasals, the fact that they are inherently (i.e. redundantly) voiced means that they cannot license [voice], yet the constraint NasVoi requires [voice] on nasals. An example tableau illustrating the interaction of these constraints is given in (14).
The question now is which candidate (and therefore which ranking) is correct. This is answered by the patterning of this type of form with respect to Rendaku and Lyman's Law. Example (11a), in which Rendaku has applied, demonstrates that the /m/ is not treated as a voiced segment. This indicates that the first ranking in (14) is correct since it appears that (b) is the correct representation for the morpheme and it is the first ranking (License >> NasVoi) which selects (b) as the output candidate.

The next case to address is the one in (13) in which nasal segments appear to share the feature [voice] with an obstruent. A tableau evaluating several candidates is given in (15).

<table>
<thead>
<tr>
<th>Candidates</th>
<th>License</th>
<th>NasVoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. tompo</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. tompo</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. tombo</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This cluster behaves like a voice segment with respect to Rendaku and Lyman's law, so it will not have the same representation as kami, but instead must carry the feature [voice]. Since License is highly-ranked, we cannot simply allow the feature to be unlicensed as in (b). However, in the case of nasal-obstruent clusters, there is a third option in which the feature [voice] may be present to satisfy NasVoi and at the same time be properly licensed: the obstruent can license the feature [voice] which it shares with the nasal.

A key point that IMP make is that whatever voice specification nasals have in the input representations, the constraints as they are will force the same output representation. This output representation may itself be underspecified, as they note:

*Underspecification, then, is an emergent property of the output.*

*Whether redundant voicing is underlyingly present or not, the outputs converge on the same output core (parsed substructure), with /m/ not linked to voice.* (IMP 1995: 589)

Thus the authors do not seek to get rid of underspecification altogether, since it is crucial in the case of single nasal consonants, but instead they wish to show the irrelevance of input specifications. The analysis still makes a distinction between representations based on the temporary absence of a feature, since presumably the /m/ in kami will be voiced in the
phonetic component. There are therefore three places where nasals can get voicing: in the underlying representation, the phonetic spellout component, and from GEN. Only the last has consequences for the phonology.

IMP thus show that in the case of nasal voicing in Japanese, the input may be irrelevant given the tension between the presence of redundant features and licensing requirements of such features. However, their analysis does not show that underspecification is incompatible with underspecified input representations except in as much as constraints hold only of output forms and not of inputs. In fact, they demonstrate that such underspecification is compatible with their analysis, even if it adds nothing to it descriptively. Therefore the inputs to tableau (15) could easily involve underspecified inputs where the nasals have no underlying feature [voice] but instead get such a feature from GEN in order to satisfy NasVoi where possible (i.e. where License may also be satisfied). In this case, assuming the presence or absence of [voice] in the input does not affect the selection of the optimal candidate.

IMP suggest that their analysis of redundant features may be extended to unmarked values of contrastive features, showing these effects to be a result of antagonistic constraints. This is precisely what is done in McCarthy (1994) in his discussion of vowel raising where there is a tension between the prohibition of a marked feature [low] and the constraint requiring the faithful parsing of such a feature. In section 3.4, I discuss this type of analysis involving antagonistic constraints and point to some implicit stipulations within such an account. First, I outline the view of markedness in OT.

3.4 Markedness and Phonological Activity

Smolensky (1993) addresses the generalization that there is a correlation between markedness of elements and their visibility in the phonology. Most generally, unmarked elements tend to be less visible and less active than marked elements. Analyses employing underspecification (such as Avery and Rice (1989), papers in Paradis and Prunet (1991)) relate the invisibility of unmarked elements to the fact that these elements are structurally distinct from marked elements in that they are underspecified. A rule cannot refer to a feature of a segment that is unspecified for that feature.

Smolensky (1993) argues that it is not the absence of unmarked elements that entails their inactivity in the phonology, but rather this inertness falls out from the unmarkedness of these elements. Since the notion of unmarkedness in OT translates into being more harmonic relative to something else, the generalization to be explained in OT terms is that more harmonic elements behave differently than less harmonic elements with respect to traditional “phonological processes”.

Smolensky discusses several scenarios with which underspecification and markedness have been associated. These include epenthesis, redundancy effects and assimilation facts. The epenthesis analysis falls out cleanly from the markedness constraints, as we saw in Section 3.2. The redundancy effects are discussed in terms of IMP (1995) in Section 3.3. The assimilation facts, however, Smolensky finds puzzling. In general, given a sequence [Coronal][Labial], assimilation results in a string of two labial consonants and never two coronal consonants (this generalization is held up in the data discussed in Avery and Rice (1989)). This pattern, as Smolensky points out, seems to generate anti-harmonic forms involving marked segments instead of unmarked segments but he offers no solution within OT for this problem.

4In fact, IMP point out that given the assumption of Lexicon Optimization of Prince and Smolensky 1993, single nasal consonants will be underspecified in the input. This follows from the fact that lexical optimization requires that the choice between several possible input representations be made on the basis of identity with the optimal candidate: since the optimal candidate in the case of single nasal candidates is one without [voice], this candidate will be closest or most faithful to an input representation that also lacks [voice].
However, Kiparsky (1994) does address the issue of assimilation in Optimality terms. In his analysis he attempts to account for the asymmetry in the assimilatory behaviour of marked vs. unmarked elements. Like Smolensky (1993), Prince and Smolensky (1993), and McCarthy (1994), Kiparsky assumes that it is the very fact that certain segments are unmarked which motivates their unique patterning in the phonology. Specifically, he seeks to show how constraints on output forms capture the generalization that unmarked segments assimilate to marked segments, but not vice versa. As a rule, he argues, both the marked and the unmarked value of a feature may spread in a particular language, but if only one feature spreads, it is the marked one. He cites Cho (1991) for voicing assimilation facts. In Russian we see the spreading of both [+voice] and [-voice]; in Ukrainian, [+voice] spreads, but no language has a process spreading only [-voice].

Kiparsky notes that in the theory of Radical Underspecification (Archangeli (1984) Cho (1991)), this asymmetry is explained by the possibility of ordering assimilation before the assignment of complement feature values. A Radical Underspecification-type approach of voicing assimilation is given in (16) and (17). In (16) is a schematic version of voicing assimilation in a language like Russian, where both values of the feature [voice] spread. The complement (default) rule inserting the unmarked feature is ordered before the assimilation rule, so both values are present for spreading. In (17) is the representation for voicing assimilation in a language like Ukrainian where the complement rule is ordered after the assimilation rule and the unmarked feature is not available for spreading. Notice that, since the marked feature is always present in the UR, it will always be active in the spreading rule.

(16) Underlying

/Rt Rt/ /Rt Rt/
/+voice/ [+voice] [+voice]

[]→ [-voice] Rt Rt Rt Rt
/+voice/ [-voice] [+voice] [-voice]

Left-Spread [voice] Rt Rt Rt Rt
‡ / ‡ /
/+voice/ [-voice] [+voice] [-voice]

Surface Rt Rt Rt Rt
\ / \ / [+voice] [-voice]
(17)
Underlying /Rt Rt/ /Rt Rt/
\ | \ [+voice] [+voice]
Left-Spread [voice] Rt Rt Rt Rt \ [+voice] [+voice]
[\→ [-voice]] Rt Rt Rt Rt \ [+voice] [+voice] [-voice]
Surface Rt Rt Rt Rt \ [+voice] [+voice] [-voice]

How are these facts accounted for in OT? Kiparsky's suggestion involves limiting the constraint vocabulary such that constraints cannot refer to unmarked feature values. Therefore, since [-voice] is the unmarked feature value for voicing, there is no constraint that refers specifically to [-voice]. In terms of constraints on place specification, this means that there is no constraint referring to the unmarked value [coronal] for consonants or [-low] for vowels. Instead, he calls for two types of related constraints: specific constraints which refer to the marked member of a category and more general constraints that refer to the entire category itself. He argues that with this reworking of the constraint set, we are able to account for the assimilation asymmetries discussed above.

First he shows that the markedness constraints as they stand cannot account for the assimilation facts. Kiparsky posits a constraint SPREAD which, as a general OCP constraint, rules out contiguous specifications for a feature type (e.g. two place features [Coronal][Labial]). This constraint should interact with other constraints to force the spreading of the marked feature. The markedness constraints *Lab and *Cor, however, wrongly predict preferential spreading of Coronal, as shown in the tableau in (18). Recall that, since [Labial] is more marked than [Coronal], *Labial is ranked above *Coronal.

(18)
Input: /...Rt Rt.../
\ | |
cor lab

<table>
<thead>
<tr>
<th>Candidates</th>
<th>SPREAD</th>
<th>*Lab</th>
<th>*Cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Rt Rt</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cor lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Rt Rt</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td></td>
<td>&lt;cor&gt; lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. &lt;cor&gt; Rt</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>&lt;lab&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The constraint SPREAD is ranked over the two other constraints since it is clearly fulfilled in the output form in which both consonants share a place of articulation\footnote{Note that I am abstracting away from directionality effects. The constraints and ranking given in this tableau will predict the same assimilation patterns regardless of whether the order of input features is [coronal][labial] or vice versa. Other constraints will come into play to limit directions of assimilation.}. The problem is that given the constraint ranking based on the universal markedness hierarchy, the less-marked coronal feature should always be the one that spreads. The (c) candidate should be preferred over the (b) candidate since parsing a coronal feature should be better than parsing a labial feature. In reality it is the (b) candidate that wins, forcing Kiparsky to conclude that these are not the relevant constraints to determine the pattern of assimilation. Instead he suggests that the appropriate constraints are PARSE constraints from the faithfulness family of constraints. Using these constraints and referring only to marked features (i.e. non-coronal), we can establish a ranking which selects the correct output form. This ranking is given in the tableau in (19).

\begin{tabular}{|c|c|c|c|}
\hline
Candidates & SPREAD & PARSE\textsubscript{lab} & PARSE\textsubscript{place} \\
\hline
a. $\text{Rt Rt}$ & \text{*!} & & \\
\hline
b. $\text{<cor> lab}$ & & \text{*} & \\
\hline
c. $\text{Rt<lab>}$ & \text{*!} & \text{*} & \\
\hline
\end{tabular}

The first candidate is ruled out by SPREAD, since both place features are parsed. The second and third candidates differ only in which feature is unparsed. Since PARSE\textsubscript{lab} is higher ranked than the more general constraint PARSE\textsubscript{place}, the second candidate in which coronal is unparsed wins.

While Kiparsky's analysis does seem to account for the assimilation facts without reference to underspecification, I think we should closely examine what is encoded in the constraints he sets up. His constraint vocabulary is limited to allow two types of Faithfulness constraints: specific constraints referring only to marked features, and more general constraints referring to a class of features as a whole. The lack of constraints referring specifically to unmarked elements has the effect of making unmarked elements invisible except as a member of a feature class. This invisibility of unmarked elements relative to marked elements has serious implications for Faithfulness. For example, the Parse family of constraints ensures that input features get parsed in the output. However, given Kiparsky's constraint vocabulary, the Parse constraints are only able to refer to marked elements or the class as a whole. This means that the Parse family will have a bias for preserving marked elements. Why should markedness be encoded in Faithfulness in this way? What is it about marked elements that allows them special status with respect to Parse? Kiparsky seems to be building underspecification into his constraints: by stipulating that Faithfulness cannot see unmarked elements, he claims that those features have no
if Parse ignores unmarked features, how do we know those features are there in the first place?

My next question is whether an Optimality Theoretic analysis can account for assimilation without building underspecification into the constraints. That is, how can we get the same facts as Kiparsky's analysis without stipulating limitations on the constraint vocabulary? The crucial generalization that Kiparsky's constraints capture is a bias for faithfulness to marked elements. This is the generalization that puzzled Smolensky (1994): why do we see the preservation of marked features when their loss or replacement by unmarked features would result in a more harmonic form?

An initially attractive answer to this question is in terms of exploded Faithfulness constraints: if the constraint PARSEfeature is broken down into a set of distinct constraints governing different features, this opens up the possibility for other constraints to interact separately with individual features. This is the tactic taken by McCarthy 1993 in his analysis of certain vowel alternations in Arabian Bedouin Arabic. In this account, the ranking of PARSE-pharyngeal >> PARSE-high means that where a grammar highly-ranks a constraint which restricts the parsing of V-place features, it is a worse offence to fail to parse [pharyngeal] than to parse [high]. Thus high vowels are the targets for a syncope process which does not target low vowels. This type of asymmetrical treatment of V-place features bears a striking resemblance to the assimilation patterns discussed above: assimilation targets coronal consonants while it does not affect non-coronals. Returning to the coronal case, and following the example of McCarthy (1993), we might assume a set of constraints governing the parsing of consonantal place features such as in (20) and (21).

(20) PARSE(cor)

The feature [coronal] if present in the input must be parsed in the output.

(21) PARSE(-cor)

Non-coronal input place feature specifications must be parsed in the output.

The ranking of PARSE(-cor) >> PARSE(cor) will mean that given a constraint forcing assimilation of two adjacent consonants (such as Kiparsky's SPREAD constraint), a coronal will always assimilate to a non-coronal: since parsing a non-coronal is more important that parsing a coronal feature, it will always be the non-coronal feature that is shared and the coronal feature which goes unparsed. Below I present a series of tableaux evaluating candidates for different place assimilation environments. In (22), I show a candidate set for an underlying coronal + labial sequence, in which assimilation will give a labial-labial output.

---

6Although the analysis changes somewhat in McCarthy 1994, he maintains the same exploded PARSEfeature constraint set to account for these facts.
Since SPREAD is highly-ranked, the first candidate with two place specifications is ruled out. The other two candidates both have linked structures, but the third candidate fails to parse the labial feature and is ruled out by PARSE-cor. The second candidate is successful since it violates only the lower-ranked PARSE-cor. This tableau demonstrates the ranking SPREAD >> PARSE-cor and PARSE-cor >> PARSE-cor.

In (23) I give a tableau evaluating a candidate set for the input sequence *dorsal + labial*. In this example the assimilation fails, giving the output *dorsal + labial*.
PARSEmarked >> PARSEunmarked, since this is the cross-linguistic pattern of assimilation. Since these constraints cannot be re-ranked with respect to one another, it would be best for this fixed ranking to fall out from something other than stipulation. Other fixed hierarchies in OT such as the markedness constraints *F, are based on a scale of widely motivated markedness generalizations. The ranking PARSEmarked >> PARSEunmarked, however, is a ranking that is the opposite of these harmonic constraints. Either this generalization is left unexplained or the arbitrary nature of this reverse hierarchy needs to be investigated. Thus not only is there no explanation for this fixed ranking, it seems to counter the harmonic ranking *MF >> *UF.

4. Underspecification in Optimality Theory

In this section I will show how assuming underspecification of coronals in the input representation of forms accounts elegantly for the assimilatory asymmetries discussed above. Using general faithfulness constraints, I show why unmarked elements are consistently targets of assimilation and why they themselves fail to trigger such assimilation. I then address some the concerns raised by theories of underspecification and argue that, within Optimality Theory, many criticisms of underspecification lose their strength.

4.1 Underspecified Input

The issues raised in the previous sections involve the apparent asymmetricality in the behaviour of unmarked elements with respect to spreading and delinking effects. Unmarked elements are targeted for spreading and fail to trigger delinking. In terms of Optimality Theory, the relative markedness of an element seems to have a direct implication for its status in the eyes of Faithfulness constraints. In this section I propose an analysis which employs the use of underspecified representations and, in doing so, avoids having to demand of Faithfulness that it have an unexplained preference for marked elements. Specifically, I am assuming that the feature [coronal] is not present in the specification of consonants in languages which exhibit the assimilation patterns discussed above. Instead, this feature is filled in by GEN where ever a place specification is required and spreading from another consonant is not possible.

In my analysis, I refer to two constraints governing faithfulness: MSEG and PARSEplace, as well as the constraint SEGHEAD introduced in section 3.2, repeated in (25). The constraint MSEG is proposed in McCarthy (1993), (1994), requiring elements in the output to have some morphological affiliation.

(24) MSEG

Every phonological element (segment, feature, μ, etc) belongs to a morpheme.

This constraint prohibits any output features not sponsored by a morpheme in the input.

(25) SEGHEAD

Segments must have a specification for place.

This constraint requires a place feature for every segment.

(26) PARSEplace

Input place features must be parsed.
This constraint ensures that any underlying place features (regardless of their markedness) will be parsed.

The ranking of these constraints relative to one another will lead to the selection of a fully specified output representation regardless of the input. This echoes the generalizations of IMP (1995) from section 3.3. However, assuming an underspecified representation of unmarked segments in the input provides an answer to the questions raised in connection with assimilation facts. Below, I address each question in turn.

**Question 1: Why are unmarked elements targets?**

Following Paradis and Prunet (1991), Avery and Rice (1989), and others, I assume that plain coronals are underlyingly unspecified for place in languages which exhibit the asymmetrical assimilation patterns discussed above. In the tableau in (27), I show the evaluation of a set of possible candidates given an underspecified input.

(27)

Input: 

<table>
<thead>
<tr>
<th>Candidates</th>
<th>SEGHEAD</th>
<th>PARSEplace</th>
<th>MSEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Rt Rt</td>
<td></td>
<td></td>
<td>!*</td>
</tr>
<tr>
<td></td>
<td>cor</td>
<td>lab</td>
<td></td>
</tr>
<tr>
<td>b. if</td>
<td></td>
<td></td>
<td>!*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lab</td>
<td></td>
</tr>
<tr>
<td>c. Rt Rt</td>
<td></td>
<td></td>
<td>!*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Given an underspecified input, GEN will provide candidates with and without place features. However, since SEGHEAD is highly-ranked, a feature must be found for the underlyingly placeless consonant. The third candidate lacks a place feature for the first root node and is therefore ruled out by SEGHEAD. A feature may be inserted as in (a), incurring an MSEG violation, but there is still a more preferable option. In (b), the underlyingly placeless root node shares a place with the following root node. This candidate violates neither SEGHEAD nor MSEG, and is therefore optimal. This ranking will force underspecified elements to assimilate whenever possible. By SEGHEAD, a place feature is always required. Given the choice between inserting a feature (and violating MSEG) and sharing an underlying feature, this constraint set will always take the shared-feature option.

**Question 2: Why are marked things non-targets?**

One of the generalizations described in Avery and Rice (1989) is that non-coronals do not assimilate to the extent that coronals do. I suggest that this is not a reflection that non-coronals are generally underspecified.

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7Epenthetic (or non-underlying) features are shown in bold.
8This option will of course violate a constraint such as NOLINK (IMP (1995)) which prohibits linked structures. However, since a linked (or assimilated) structure is obviously optimal, such a constraint must be low-ranked relative to the Faithfulness constraints discussed here.
Faithfulness bias towards marked elements as the previous accounts, but as a reflection of the consistency of Faithfulness: underlying features must be parsed. In the tableau in (28) I show the application of Faithfulness in the parsing of two non-coronals. 

(28) 
Input: /. . Rt + Rt../

<table>
<thead>
<tr>
<th>Candidates</th>
<th>PARSEplace</th>
<th>*-cor</th>
<th>*cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. <em>a</em> Rt Rt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dor lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Rt Rt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>\</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;dor&gt; lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Rt Rt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 /</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dor &lt;lab&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The first candidate has both input place features parsed, incurring two violations of *-cor, but satisfying the higher-ranked PARSEplace. The other two candidates involve assimilatory affects, where one of the input features is not parsed and the remaining feature is shared by the two root nodes. While this reduces the number of marked features, the failure to parse input features rules them out.

The ranking of the Faithfulness constraint PARSEplace over the markedness constraints determines the selection of an output in which two marked elements are realized and no linked structures result. Neither segment assimilates but not because they share a special status with respect to Faithfulness as marked elements. Instead, Faithfulness is unbiased: it cares only that the underlying features are parsed in the output. Since both segments have underlying place specifications, faithfulness will assure that both features are parsed and no assimilation results.

**Question 3: Do we still see the emergence of the unmarked?**

In the next tableau we see a case where there is no place features at all in the input. Instead, these features will be supplied by GEN and evaluated by the markedness constraints.

---

9The only directly relevant Faithfulness constraint in this case is PARSEplace. MSEG will only serve to rule out candidates with gratuitous epenthetic features substituted for the underlying ones.
Input: /...Rt + Rt.../

<table>
<thead>
<tr>
<th>Candidates</th>
<th>SEGHEAD</th>
<th>MSEG</th>
<th>*-cor</th>
<th>*cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Rt   Rt</td>
<td></td>
<td>**!</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Rt + Rt</td>
<td>**!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ^Rt + Rt</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>\</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Rt + Rt</td>
<td>*</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td></td>
<td>\</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lab</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since SEGHEAD is highly ranked, a candidate without place features (such as (a)) is immediately ruled out. Since SEGHEAD needs to be satisfied and there are no input place features, GEN will have to supply them at the cost of violating MSEG. MSEG should be minimally violated, so a single epenthetic feature shared by the two roots is preferable over the insertion of two features as in (b). The remaining two candidates differ only in which feature is inserted. Here the markedness constraints come into play: since labial is more marked than coronal, the candidate with the coronal feature will win. Notice that, although the feature [coronal] is not part of the input specification of these consonants and therefore does not serve to distinguish these consonants from others in the inventory, it is inserted in the output by GEN as the default place feature since it is the least marked place feature universally.

This analysis allows Faithfulness to apply consistently and without bias. Restriction of the constraint vocabulary is not required nor is an arbitrary reverse markedness hierarchy called in to play. Instead, the Faithfulness constraints serve only to evaluate candidates on the basis of their identity with the input.

4.2 Underspecification in a non-derivational theory.

While I have taken the notion of underspecification from derivational theories, the analysis which I propose does not make use of levels or rule ordering. Instead, there are only the input and output representations and constraints governing the relation between them. This shift from a multi-level derivational approach clears up some of the problems with underspecification accounts, leaving some criticisms of underspecification groundless.

McCarthy and Taub (1992) raise some concerns over the purported underspecification of coronals (Paradis and Prunet 1991). The problems they discuss involve cases where it seems that coronal consonants must be specified for [coronal] in the phonology. For example, they note that in American English, there is a prohibition on initial coronal + yu. Also, vowel/zero alternations in the plural, genitive, and preterite suffixes rely on the presence of [coronal]. These and other cases discussed seem to point to a paradox involving underspecification of [coronal] and the OCP: how can the OCP hold over features that are not present?

These criticisms are no longer valid in an underspecification/OT account such as the one proposed here: since [coronal] is present in the output candidates, it is visible to the
OCP and other co-occurrence restrictions. The differences between underspecified elements and those that are underlying arise from their difference with respect to faithfulness: only underlying elements incur Parse violations and only non-underlying elements incur MSEG violations.

5 Conclusion: Underspecification and the Role of Faithfulness

In this paper I have presented the arguments against underspecification in OT and shown that, although underspecified input representations are not required to account for all cases such as in redundant voicing of nasals in Japanese, they are not necessarily incompatible with the theory. I have demonstrated that the inactivity of unmarked elements in place assimilation patterns is in fact best accounted for using underspecification in OT. I suggest that the asymmetries with respect to phonological activity found between marked places of articulation and coronal place of articulation fall out from input representations. The feature coronal is not present in the input specifications of consonants but is sometimes inserted by GEN where a default place feature is required. These underspecified representations interact in crucial ways with Faithfulness constraints, but the constraints themselves do not have to be modified so as to render them blind to unmarked elements. Instead, unmarked elements which are not present in the input fall under the purview of MSEG constraints while those which are present are governed by Parse. While in this paper I have only examined the behaviour of unmarked vs. marked place specifications, the issue of markedness and underspecification of other feature types remains to be explored within the OT framework.

References


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10An interesting direction for further research is where it has been suggested that unmarked features are in fact underlying in some cases. For example, Avery and Rice (1989) propose a node activation condition which basically allows [coronal] to be present underlyingly if contrasts in the inventory of a language elaborate the coronal region so as to involve dependants of the coronal node. My analysis makes the prediction that such complex segments should pattern with the non-coronals with respect to assimilation since [coronal] will be an input feature.