Markedness and Context Effects in the Acquisition of Place Features

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1. INTRODUCTION

Children's acquisition of consonantal place distinctions bears on a number of important empirical and theoretical issues in phonology. First, it has long been held that place features can be scaled for their relative markedness with dorsal place being considered more marked than coronal place (e.g., Jakobson 1968). Contemporary theories of phonology have attempted to model the markedness of place features by various means, including underspecification, feature geometry, constraints on rules, fixed constraint hierarchies, and stringency relations among constraints (e.g., Paradis and Prunet 1991; Prince and Smolensky 1993; Kiparsky 1994; Lombardi 2001; de Lacy 2002). One consequence of the unmarkedness of coronal place for acquisition is that we might expect some children to include in their segmental inventories both dorsals and coronals, others to include coronals without the more marked dorsals, but no children should include dorsals without also including the less marked coronals. Additionally, in terms of non-assimilatory substitution patterns, we might expect some children to replace target dorsals with less marked coronals, but we would not expect any child to replace target coronals with more marked dorsals.

A second implicational universal that impacts place features involves a contextual asymmetry. It has been observed in fully developed languages that some contexts are stronger—perceptually more salient or more prominent than
others — and that it is these strong contexts that license place features (e.g., Itô, Mester, and Padgett 1995; Steriade 1995; Beckman 1998; de Lacy 2002; Smith 2002). Some examples of strong contexts include word-initial syllables, stressed syllables, syllable onsets, and foot-initial position. In trochaic languages, these contexts often converge on word-initial position. The asymmetry is that contrasts tend to be preserved and even enhanced in these strong contexts but are often neutralized or merged in weaker contexts (e.g., in syllable-final, word-final or foot-medial position). These weak positions tend to converge on post-vocalic position. A particular instantiation of this asymmetry as it relates to place features across languages is that the number and type of place distinctions in weak positions does not exceed the number of place distinctions in strong contexts (Beckman 1998; Parker 2001; de Lacy 2002). This means that strong and weak contexts might have the same number of place distinctions, or strong contexts might have more place distinctions than weak contexts, but weak contexts should not exhibit more place distinctions than strong positions. This asymmetry has been attributed in part to the processing advantage that strong positions afford for word recognition and the greater perceptual salience of the acoustic cues for place features in the transition from a consonant to a following vowel (e.g., Steriade 1995; Smith 2002). In terms of acquisition, then, we might expect children to acquire new place distinctions in more prominent positions before acquiring them in weaker positions. Similarly, we would not expect children’s substitution patterns to merge place distinctions in strong positions unless they were also merged in weak positions.

Various proposals have been put forward within Optimality Theory to account for these presumed asymmetries, and they serve as testable predictions for acquisition. Markedness scales relating to place of articulation (and sonority) have been handled by fixed constraint rankings (Prince and Smolensky 1993) or stringency relations among constraints (de Lacy 2002; McCarthy 2002). Contextual asymmetries have been achieved in a different way. That is, faithfulness and markedness constraints can be interleaved such that at least one of those constraints incorporates positional considerations and is a special case of another, yielding a positional faithfulness constraint and/or a positional markedness constraint (Beckman 1998; Zoll 1998; Smith 2002). The relationship among constraints and the contexts that are appropriate to the formulation of those constraints are both empirical matters that have theoretical consequences for what is and is not in the universal constraint set.

The purpose of this article is twofold: to evaluate the empirical adequacy of the above claims with respect to the acquisition of place distinctions and to put forward an optimality-theoretic account that is capable of providing for the observed typological variation. Our account will be argued to require independently formulated and freely permutable place-referring constraints. The Developmental Phonology Archive at Indiana University will serve as the primary empirical base against which these claims will be evaluated. Connections will also be made with
reports in the literature on normal development and fully developed languages. The article is organized as follows. We begin in section 2 by providing some background on fixed rankings and stringency relations for place features within Optimality Theory. In section 3, we present results relating to place distinctions from a cross-sectional archival study of 211 children with phonological delays. Section 4 presents evidence and analyses for two case studies drawn from the archive that directly challenge some of the above claims. In one of these cases, coronal stops are excluded from the child’s inventory and are moreover replaced by dorsals. In the other case study, coronals and dorsals both occur in weak (post-vocalic) contexts, but coronals are prevented from occurring in a strong context (i.e., word-initially), being replaced by dorsals. The discussion in section 5 considers some issues that arise from these results, including a possible solution to the disparities between predicted and observed results, between child and adult phonological phenomena, and between normal and disordered phonologies. The article concludes with a brief summary.

2. Fixed Rankings and Stringency Relations in Optimality Theory

In this section, we briefly summarize two approaches within Optimality Theory for dealing with the markedness of place features. Both approaches bear on claims about inventory structure and substitution patterns.

It is well documented and consistent with standard assumptions about the markedness of place features that many children (normal or disordered) in the early stages of acquisition exclude dorsals from their inventories and replace them with less marked coronals (Ingram 1989; Smit 1993; Bernhardt and Stoel-Gammon 1996; Bernhardt and Stemberger 1998). This substitution pattern has been labelled “Velar Fronting”. A conventional account of context-free Velar Fronting within Optimality Theory might appeal to a fixed ranking among the two markedness constraints in (1a) such that *k universally outranks *t. Each of the markedness constraints disfavours different place features, but the fixed ranking is intended to ensure more serious violations for dorsals and to prevent the reverse ranking of these constraints. The faithfulness constraint in (1b) is antagonistic to the markedness constraints and demands that input place features be preserved in the output. The formulation of this faithfulness constraint temporarily ignores details about the preservation of individual place features and is intended as an abbreviation for a larger set of faithfulness constraints to be elaborated below.

(1) Some place constraints:
   a. Markedness constraints:
      *k: Avoid dorsals.
      *t: Avoid coronals.
   b. Faithfulness constraint:
      ID[place]: Preserve input place features in the output.
By ranking the faithfulness constraint between these two markedness constraints (as in (2)), we can see how coronals would be realized faithfully but dorsals would be replaced by coronals. We have limited the candidate set to the two most relevant candidates, but clearly, other highly ranked faithfulness constraints militating against insertion, deletion, and other feature changes would be necessary to eliminate the many other potential competitors.

(2) Context-free velar fronting:
Ranking: *k >> ID[place] >> *t

<table>
<thead>
<tr>
<th>/ki/ 'key'</th>
<th>*k</th>
<th>ID[place]</th>
<th>*t</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ki</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ti</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/ti/ 'tea'</th>
<th>*k</th>
<th>ID[place]</th>
<th>*t</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ki</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ti</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The fixed ranking of these markedness constraints is also consistent with a different typological situation where coronals and dorsals contrast in all contexts and are both realized faithfully as in adult English. This would be achieved by ranking the faithfulness constraint above both markedness constraints as in (3).

(3) Adult English (no Velar Fronting):
Ranking: ID[place] >> *k >> *t

The fixed ranking among these markedness constraints is obviously more difficult (but not impossible) to discern when both are dominated by an antagonistic faithfulness constraint. That is, even subordinated markedness constraints can sometimes exercise influence (called “emergence of the unmarked” in McCarthy and Prince 1994). The more important point is that the one possibility precluded by the fixed ranking is for *t to dominate both *k and ID[place]. This presumably illicit ranking would predict that there could be inventories with dorsals but not coronals. Interestingly, some fully developed languages (e.g., Hawaiian and Yellowknife Chipewyan) have gapped inventories of just that type (Hass 1968; Pukui and Elbert 1979). While such inventories might pose a problem for the fixed ranking of place constraints, they have instead been shown to follow from an alternative proposal which takes advantage of stringency relations among constraints but which also retains the marked character of dorsals over coronals to

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1As noted by an anonymous reviewer, Hawaiian exhibited a historical shift from [k] to glottal stop and from [t] to [k]. Yellowknife Chipewyan includes the voiceless unaspirated stops, [d] and [g], but for the voiceless aspirated stop series, [t] merges with [k] for some speakers. There is also a glottal stop in Chipewyan.
account for neutralization phenomena (de Lacy 2002). Some of the key elements of the proposal are that there is greater pressure to preserve highly marked place features such as [dorsal] (and sometimes [labial]) and that hierarchical markedness relations among place features can be ignored but not reversed. These ideas are implemented by certain conditions on constraint formulation. For place faithfulness constraints, this requires that unfaithful mappings of unmarked coronals also result in violation marks for unfaithful mappings of more marked dorsals, but not vice versa. Similarly, for place markedness constraints, if unmarked coronals incur a violation, then more marked dorsals also incur a violation of that same constraint. By formulating the constraints in a stringency relation, the constraints no longer need to be fixed in their ranking, but rather, are freely permutable.

An additional important observation about inventories in fully developed languages that include dorsals but not coronals is that they also tend to include glottal consonants, which are presumably even less marked than coronals (Lombardi 2001; de Lacy 2002). To account for a gapped inventory of this type, de Lacy employed stringently formulated constraints similar to those in (4). We will ignore constraints related to labial place because, at least for the acquisition facts that we will be considering, labials tend not to be realized unfaithfully or as substitutes for other places.

(4) Stringently formulated constraints:

a. Markedness:
   *k: Avoid dorsals.
   *kt: Avoid dorsals and coronals.
   *kth: Avoid dorsals, coronals, and glottals.

b. Faithfulness:
   ID[k]: Preserve input dorsals in the output.
   ID[kt]: Preserve input dorsals and coronals in the output.
   ID[kth]: Preserve input dorsals, coronals, and glottals in the output.

Before considering how stringency relations account for gapped inventories, let us return briefly to the Velar Fronting error pattern and its characterization within this framework. It is a simple matter to account for the exclusion of dorsals by ranking *k over ID[kt]. This ranking would also permit coronals to be produced target appropriately and as substitutes for dorsals, provided additionally that ID[kt] outranked *kt.  

\footnote{For a fuller discussion about the relative markedness of labial place, see de Lacy (2002:193–194). The markedness of labial place relative to coronal is also controversial (e.g., Hume and Tserdanelis 2002). It may be that our proposal extends to all place-referring constraints, allowing them to freely vary in their ranking. The cross-linguistic rarity of labial unmarkedness might then be accounted for in the same way we propose to account for dorsal unmarkedness, namely by appealing to preference constraints (see section 5.1).}

\footnote{If glottals were also to occur in the inventory, but not as substitutes for other sounds, *k would remain undominated, but it would instead be ID[kth] that outranked *kth.}
These same constraints can account for a gapped inventory that includes more marked dorsals while excluding less marked coronals by first ranking ID[k] over all of the other constraints. The exclusion of the coronals would moreover follow from the ranking of *kt over ID[kth]. The tableaux in (5) illustrate these two outcomes for a hypothetical input /k/ and /t/, respectively.

(5) Tableaux for a gapped inventory:

<table>
<thead>
<tr>
<th></th>
<th>/ki/ ‘key’</th>
<th>/ti/ ‘tea’</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ranking:</strong></td>
<td>ID[k] &gt;&gt; *kt &gt;&gt; ID[kth]</td>
<td>ID[k] &gt;&gt; *kt &gt;&gt; ID[kth]</td>
</tr>
<tr>
<td><strong>/ki/ ‘key’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. ki</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. ti</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>c. hi</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td><strong>/ti/ ‘tea’</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. ki</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. ti</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. hi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the first tableau, the two less marked and unfaithful candidates, (b) and (c), are eliminated by their violation of undominated ID[k], yielding the more marked, but faithful output with a dorsal. In the second tableau, the faithfulness constraint ID[k] is irrelevant to an input coronal and thus contributes nothing to the evaluation of the candidates. The markedness constraint *kt in this instance assigns fatal violations to candidates (a) and (b), effectively eliminating coronals from the inventory along with dorsals that correspond with coronals. While glottals would incur a violation of ID[kth], the more marked competitors incur more serious marks. Consequently, with these constraints and this ranking, glottals are predicted to occur in the inventory, either faithfully or as correspondents of coronals. Importantly, as these constraints are formulated, the more marked dorsals cannot be correspondents of less marked coronals no matter how the constraints are ranked.

Gapped inventories of this sort evidently can and do occur in fully developed languages, and de Lacy’s proposal provides for them in a way that fixed rankings cannot. Thus, while inventory structure has long been taken as support for claims

Additionally, some other low-ranked markedness constraint would be necessary to eliminate glottals as substitutes for other sounds. That constraint might demand, for example, that consonants have place (Parker 2001). This otherwise inactive markedness constraint (being dominated by ID[kth]) would favour a coronal over a glottal as an unfaithful correspondent of a dorsal in the case of a tie. It is also the case that glottals are sometimes restricted to weak contexts due to a markedness constraint that demands that consonants in strong contexts have a place feature (Parker 2001).
about markedness, it may be that other factors (e.g., substitution patterns) are more relevant to claims about the markedness of place features. We might then expect developing systems to exhibit gapped inventories without necessarily impacting the validity of place markedness. However, we should still not expect gapped inventories to replace less marked coronals with more marked dorsals, especially if glottals occur in the inventory.

As a test of these claims and proposals, we turn in the next section to an analysis of coronal and dorsal place distinctions and substitution patterns for 211 children with phonological delays.

3. **Archival Study**

The Developmental Phonology Archive at Indiana University will serve as the primary empirical base for documenting the occurrence and prevalence of these place-related error patterns. The Archive contains production data from 211 children (ages 3:0 to 8:6; M = 4:5) with functional phonological delays. Data from 162 of the 211 children (Archive 1) were collected as part of an NIH funded project on the learnability of sound systems (DC 01694). Data from the remaining 49 children (Archive 2) were independently collected and have been described elsewhere (e.g., Dinnsen, Chin, Elbert, and Powell 1990). All of the children were monolingual speakers of English and evidenced delays in phonological development. The children scored on average at the 5th percentile relative to age and gender matched peers on the Goldman-Fristoe Test of Articulation (Goldman and Fristoe 1986). The children’s phonological delays were functional in nature as characterized by normal hearing, oral-motor skills, and receptive vocabulary. Data for the children in the archive consist of spontaneous word productions that were elicited during a standard picture-naming task. Data consist of words that were carefully selected to sample all target phonemes in English in initial, medial, and final position and in multiple exemplars. The speech samples were recorded and phonetically transcribed for purposes of analysis. In general, transcription reliability was calculated for approximately 10% of each child’s data set in the archive with mean consonant-to-consonant agreement at 90% or greater.

Data were extracted from this corpus to examine children’s word-initial productions of target dorsals and coronals. Our focus was on word-initial position because it is this context that the literature has identified as the most vulnerable for these error patterns (e.g., Chiat 1983; Stoel-Gammon 1996; Inkelas and Rose 2003). Medial and final word positions were not considered in the archival analysis reported here because they are often subject to other unrelated error patterns (e.g., more general neutralizations or deletions) and therefore present other difficulties for classification. Moreover, recall that the goal of the archival study was to test the hypothesis that children should not replace less marked coronals with more marked dorsals. Given this, an examination of children’s substitutions in the strong context of word-initial position is sufficient. The prevalence statistics for children
Table 1: Prevalence statistics in Developmental Phonology Archive

<table>
<thead>
<tr>
<th>Error Pattern</th>
<th>Archive 1</th>
<th>Archive 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=162)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Word-initial Velar Fronting</td>
<td>64</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>39%</td>
<td>39%</td>
</tr>
<tr>
<td>b. Word-initial Coronal Backing</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>c. No Coronal Backing or Velar Fronting</td>
<td>84</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>52%</td>
<td>53%</td>
</tr>
<tr>
<td>d. Other</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>

in the Developmental Phonology Archive are shown in Table 1. Percentages relate to the proportion of children who exhibit one of these error patterns based on a 50% usage criterion. For a given child to be classified as having (a), Word-initial Velar Fronting, the child had to substitute coronal for dorsal stops in at least 50% of the relevant words sampled. Likewise, to be classified as (b), Word-initial Coronal Backing, a child had to substitute dorsal for coronal stops in at least 50% of the words sampled. Children with accurate productions of coronal and dorsal stops in at least 50% of the words sampled were classified as (c), No Coronal Backing or Velar Fronting. Category (d), “Other”, was included to account for children evidencing error patterns that differ from the substitution of dorsals for coronals or vice versa (e.g., Word-initial deletion, Spirantisation, Deaffrication). The 50% criterion also had an added benefit of preventing the misclassification of cases in which consonant harmony might have applied. That is, because words used to sample target dorsals and coronals word-initially varied in phonological composition (e.g., Dorsal-Vowel-Coronal, Dorsal-Vowel-Labial), children could not achieve the 50% criterion with only productions attributable to assimilation processes.

There was no statistical difference in the percentages obtained from the two independently collected archives \( \chi^2(3, \ N = 49) = 0.33 \) (\( p > 0.05 \)). Collectively, over 50% of the 211 children did not evidence errors in word-initial dorsals and coronals. As expected, the most prevalent error pattern was Velar Fronting, which occurred in 39% of the cases. Coronal Backing was much less frequent, occurring in only 4% of the cases. The prevalence of Velar Fronting is wholly consistent with Bernhardt and Stoel-Gammon’s (1996) finding that 41% of the 22 children with phonological delays they examined (ages 3 to 6) evidenced Velar Fronting. However, they report that 18% of the 22 children with phonological delays evidenced substitutions of dorsals for other places. This is considerably higher than the 4% prevalence of Coronal Backing found in this investigation. Moreover, expanding our classification to include labials would not have increased the prevalence because none of the children in the Developmental Phonology Archive substituted dorsals for labials. One possible explanation for the difference between investigations is the criterion level used to classify children as evidencing a particular substitution pattern. Bernhardt and Stoel-Gammon (1996) utilized a 20% criterion to say that a child was using a particular place of articulation, but
do not state whether this same percentage of usage determined the presence of an error pattern. It is nevertheless striking how similar the results are from the two independent archives that constitute the Developmental Phonology Archive at Indiana University.

The findings of the archival study reveal that while Velar Fronting is a more common substitution pattern in word-initial position, there are cases of coronal backing in which more marked dorsals are substituted for less marked coronals. This is especially noteworthy given that all of the children with the Coronal Backing error pattern included glottals in their inventories. We will now present two representative cases of Coronal Backing to illustrate the implications of this error pattern for constraint rankings within Optimality Theory. These two children were selected as opposed to other children who evidenced Coronal Backing because they included consonants of interest in initial, medial, and final positions.

4. CASE STUDIES

The next two subsections present data and analyses for the two children from the archive who exhibited different versions of the Coronal Backing error pattern. The first case involves a gapped inventory and a context-free substitution pattern. The second case involves a more elaborate inventory with a positional restriction on the Coronal Backing error pattern.

4.1. A gapped inventory with a context-free substitution pattern

The data in (6) are from Child LP13 (age 4;7). This child was originally recruited for participation in an experimental treatment study. He scored below the 1st percentile on the Goldman-Fristoe Test of Articulation (Goldman and Fristoe 1986), but scored within normal limits on tests of hearing, oral-motor skills, and receptive and expressive language. The data in (6) were drawn from his pretreatment phonological sample. The forms in (6a) show that dorsals were produced target appropriately in all contexts, except for some voicing (voice onset time) problems in word-initial position which need not concern us here. The forms in (6b) are illustrative of two other important facts. First, this child excluded coronal stops from his inventory, resulting in a gapped inventory. Second, he replaced them with more marked dorsals in all contexts, thus illustrating the Coronal Backing error pattern. A Coronal Backing process is especially surprising here given

4While coronals are typically reduced to glottal stops or flapped in medial position in adult English, Klein and Altman (2002) provide evidence that this production process is acquired later in the course of typical development. In earlier stages, target coronals are often produced in an unreduced form.

5Word-initial coronal fricatives were also realized as dorsal stops. Word-final voiced coronal stops were usually omitted, and word-medial voiced coronal stops were realized as a palatal glide.
that less marked glottals, as in (6c), did occur in this child’s inventory and might have been expected to be the preferred substitutes for coronals.\textsuperscript{6} It is important to observe that dorsals (whether faithful or not) often occurred in contexts that could not reasonably be attributed to some consonant harmony process or assimilation from an adjacent vowel (n.b. ‘eat’).

(6) Child LP13 (age 4;7):
   a. Dorsals produced target appropriately:
      \[ g\text{ab} \] ‘cob’ \[ b\text{ak}\text{?} \] ‘pocket’ \[ ba\text{k} \] ‘back’
      \[ go\text{um} \] ‘comb’ \[ \text{ak} \] ‘rock’
   b. Coronals replaced by dorsals (Coronal Backing):
      \[ go\text{nf} \] ‘toes’ \[ b\text{akn} \] ‘button’ \[ ba\text{k} \] ‘bite’
      \[ k\text{i} \] ‘teeth’ \[ ik\text{n} \] ‘eating’ \[ ik \] ‘eat’
   c. Glottals occur:
      \[ i\text{j} \] ‘hill’ \[ ?\text{e}\text{mr} \] ‘hammer’ \[ k\text{ih}\text{ar}s \] ‘treehouse’

It should be clear from the foregoing that these facts call into question claims about the relative markedness of place features and the appropriateness of fixed rankings or stringency relations among place constraints. The gapped character of Child LP13’s inventory may not be a problem for stringency relations, but the associated substitution pattern is. Our proposal is to ease the restrictions on place-referring constraints so that they are freely rankable and independently formulated.\textsuperscript{7} The constraints in (7) are among those that are relevant.

(7) Freely permutable and independently formulated place constraints:
   *k: Avoid dorsal place.
   *t: Avoid coronal place.
   ID[k]: Preserve input dorsal place in the output.
   ID[t]: Preserve input coronal place in the output.

The tableaux in (8) illustrate the proposed account for Child LP13’s Coronal Backing error pattern and the associated target-appropriate realization of dorsals. Our focus in these tableaux is on word-final position, but the effect would be the same in any other context given the unrestricted nature of the error pattern. Our departure from other accounts resides in the independence of the constraints and the ranking of *t over *k.

\textsuperscript{6}This may be less surprising if these error patterns are peculiar to linguals.

\textsuperscript{7}An anonymous reviewer questions whether this child might have had a perceptual problem differentiating lingual articulations. We cannot conclusively rule out this as a possible source for the production problem, but that would still not explain why the distinction was merged in favour of a dorsal rather than a coronal. The ranking of *t over *k is necessary to account for the production facts and is not compromised in any way by the potential that there might have been a perceptual problem. In fact, it is the prospect of faithful perception that poses an even greater challenge for phonological theory generally and Optimality Theory in particular. For optimality theoretic accounts of the comprehension-production dilemma, see Smolensky (1996) and Pater (to appear).
(8) Context-free Coronal Backing:
Ranking: ID[k], *t >> *k, ID[t]

<table>
<thead>
<tr>
<th>Language</th>
<th>Constraint</th>
<th>*k</th>
<th>*t</th>
</tr>
</thead>
<tbody>
<tr>
<td>/bæk/ ‘back’</td>
<td>ID[k]</td>
<td>*k</td>
<td>*t</td>
</tr>
<tr>
<td>a. bæk</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. bæt</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>/bat/ ‘bite’</td>
<td>ID[k]</td>
<td>*k</td>
<td>*t</td>
</tr>
<tr>
<td>a. bæk</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. bæt</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The first of these tableaux considers a word with a dorsal in the input which is realized faithfully. The unfaithful candidate (b) with a coronal incurs violations of both of the top-ranked constraints, either of which is sufficient to eliminate that candidate in favour of the candidate with a dorsal. The second tableau considers a word with an input coronal that undergoes Coronal Backing. The faithfulness constraint ID[k] is irrelevant in the case of an input coronal. The top-ranked markedness constraint *t does, however, assign a fatal violation mark to the coronal candidate. Importantly, *t assigns its violation mark without also assigning a mark to the dorsal candidate, allowing candidate (a) with a dorsal to survive as optimal. The result for this child is that dorsals are either realized faithfully or as substitutes for coronals.

The facts relating to Child LP13’s gapped inventory and the associated Coronal Backing substitution pattern do not support standard assumptions about the markedness of place features and are not consistent with either a universally fixed ranking of place constraints or stringency relations among those constraints. It appears instead that place-referring constraints must be formulated independently of one another and be permitted to vary in their ranking across children.

The above case study was relevant to claims about the relative markedness of place features on the basis of inventory structure (presence/absence of coronals/dorsals) and context-free substitution patterns (Coronal Backing/Velar Fronting). In the next section, we take up the interaction of these place substitution patterns with another putative implicational universal involving context.

4.2. Contextual restrictions on place substitution patterns
Claims about the markedness of place features and children’s acquisition of those features interact in unexpected ways with another presumed implicational universal involving context. The basic problem is that children often appear to deal with context in just the reverse way that adults do, at least with regard to place features (e.g., Dinnsen 2002; Inkelas and Rose 2003; Dinnsen and Farris 2003a). That is,
there is a well-established contextual asymmetry in fully developed languages that
finds the number of place distinctions in weak positions (e.g., codas or foot-medial
onsets) not to exceed the number of place distinctions in stronger contexts such
as word-initial onsets (Parker 2001). It is, however, equally well established for
developing phonologies (normal or disordered) that many children tend to acquire
certain place distinctions first in those presumably weak contexts and only later
extend place distinctions to more prominent contexts such as syllable onsets that
are either word-initial or foot-initial (e.g., Stoel-Gammon and Cooper 1984; Smit
1993; Stemberger 1996; Stoel-Gammon 1996; Dinnsen 2002; Inkelas and Rose
2003). A typical instantiation of this is for children who lack a coronal/dorsal
contrast and exhibit a context-free Velar Fronting error pattern to acquire dorsals
first in weak post-vocalic contexts. We will continue throughout to use the linearly
deﬁned term “post-vocalic position” as an abbreviation to refer to the collection
of these weak contexts (i.e., word-ﬁnally and foot-medially). We will similarly
use the term “word-initial position” as an abbreviation to refer to the collection
of strong contexts that converge on foot-initial position, stressed syllables, and
onsets. One reason for this is that the data we will be considering are insufﬁcient
to distinguish between certain prosodic formulations of context versus simple lin-
ar statements of context. In any event, the occurrence of coronals and dorsals
in post-vocalic contexts entails the partial suppression of Velar Fronting. Velar
Fronting would persist in word-initial position, yielding fewer place distinctions
in that context. The problem here is not with any claims about the markedness
of place features, especially given that dorsals are being acquired after coronals,
and coronals are being favoured over dorsals by the substitution pattern, albeit
in a more limited context. Rather, the problem is that word-initial position is
presumed to be a prominent, perceptually salient context that should enhance
contrasts (Inkelas and Rose 2003; see Smith 2002 more generally). In this case,
however, the contrast is merged word-initially and is preserved post-vocalically.

Setting aside for the moment the issue of why children and adults might
differ in their treatment of context, the persistence of Velar Fronting in word-
initial position can be accounted for by extracting from the general *k markedness
constraint a special instance of that constraint that is relativized to word-initial
position as in (9).9 Additionally, that contextual markedness constraint would be
ranked above an antagonistic faithfulness constraint ID[place]. The context-free

---

9 An alternative account is also available that employs a positional faithfulness constraint
relativised to the rhyme. The markedness constraints would be ranked below that positional
faithfulness constraint and above the context-free version of the faithfulness constraint.
Such an alternative is alluded to in the discussion (section 5.2). Under either scenario,
the constraint set must be expanded beyond what has conventionally been assumed to be
available.
versions of the markedness constraints would, in turn, be ranked below faithfulness to account for the target appropriate realizations of place post-vocally.

(9) Contextual markedness constraint banning word-initial dorsals:

*#k: Avoid word-initial dorsals.

The tableaux in (10) both illustrate how a word-initial dorsal candidate fatally violates the contextual markedness constraint *#k and is eliminated in favour of the candidate with a coronal, independent of the input place feature.

(10) Word-initial Velar Fronting:

Ranking: *#k >> ID[place] >> #k, *t

\[
\begin{array}{|c|c|c|c|}
\hline
& \text{/ki/ ‘key’} & \text{*#k} & \text{ID[place]} & \text{*k} & \text{*t} \\
\hline
\text{a. ki} & *! & * & * & * \\
\hline
\text{b. ti} & & & * & * \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|c|c|}
\hline
& \text{/ti/ ‘tea’} & \text{*#k} & \text{ID[place]} & \text{*k} & \text{*t} \\
\hline
\text{a. ki} & *! & * & * & * \\
\hline
\text{b. ti} & & & * & * \\
\hline
\end{array}
\]

The tableaux in (11) illustrate the suppression of Velar Fronting in contexts other than word-initial position, with target appropriate realization of coronals and dorsals in post-vocalic contexts. The contextual markedness constraint is not relevant in the case of post-vocalic consonants, leaving the choice to faithfulness.

(11) Velar Fronting suppressed post-vocally:

Ranking: *#k >> ID[place] >> #k, *t

\[
\begin{array}{|c|c|c|c|}
\hline
& \text{/e\k/ ‘ache’} & \text{*#k} & \text{ID[place]} & \text{*k} & \text{*t} \\
\hline
\text{a. erk} & * & * & * & * \\
\hline
\text{b. e\t} & *! & * & * & * \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|c|c|}
\hline
& \text{/e\t/ ‘eat’} & \text{*#k} & \text{ID[place]} & \text{*k} & \text{*t} \\
\hline
\text{a. ik} & *! & * & * & * \\
\hline
\text{b. it} & & & * & * \\
\hline
\end{array}
\]

Inkelas and Rose (2003) have attempted to offer an explanation for the contextual anomaly associated with Velar Fronting by appealing in part to a developmental articulatory limitation of young children. Their claim is that target dorsals will be produced with a coronal release in word-initial position due to the combination of several factors, including young children’s larger tongue size (relative to a small oral cavity) and an enhanced articulation associated with the prosodically prominent word-initial position, all of which force tongue contact
and release in the coronal region. Such an explanation runs into problems on at least two fronts. First, it fails to explain the persistence of word-initial Velar Fronting in older children whose tongue size has normalized relative to the size of the oral cavity. As our archival results show, 39% of the children exhibited Velar Fronting in word-initial position. Recall, that the children in our archival study were between the ages of 3;0 and 8;6. All of these children were examined for structure and function of the oral mechanism (Robbins and Klee 1987) and were found to be within normal limits. It might be countered that the persistence of the error pattern was the result of "phonologisation". That is, the error pattern became part of the phonology. This would be tantamount to admitting into the universal constraint set a constraint such as that in (9). This, however, is what Inkelas and Rose were trying to avoid on continuity grounds. The second problem with their explanation is that it predicts that the reverse error pattern of Coronal Backing should not occur in the same strong context of word-initial position. However, as documented in our archival study and as exemplified below by the data from Child LP76, Coronal Backing does occur in the speech of some children during the same age range that Velar Fronting occurs for other children. If articulatory factors are claimed to be responsible for Velar Fronting, it must also be claimed that children can overcome these limitations, opting for an articulatorily more difficult (and otherwise unmotivated) dorsal release for coronal consonants.

The data in (12) from Child LP76 (age 4;3) are illustrative of a Coronal Backing error pattern that is restricted to word-initial position. Data from this child were collected as part of his participation in an experimental treatment study. Child LP76 scored at the 3rd percentile on the Goldman-Fristoe Test of Articulation (Goldman and Fristoe 1986), but scored within normal limits on tests of hearing, oral-motor skills, and receptive and expressive language. As before, data were drawn from the pretreatment phonological sample. The forms in (12a) exemplify the fact that coronals and dorsals both occurred and were realized target appropriately in post-vocalic contexts (see also footnote 4). The forms in (12b) illustrate the error pattern whereby target coronals in word-initial position were replaced by dorsals. Finally, as can be seen in (12c), target dorsals were realized as dorsals word-initially. As we saw in the other case study, the errors cannot reasonably be attributed to consonant harmony or assimilation from adjacent vowels (n.b. ‘tear’).

(12) Child LP76 (age 4;3):

a. Coronals and dorsals realized target appropriately in post-vocalic contexts:

\[
\begin{align*}
\text{[bA]’} & \text{ ‘button’ } [\text{bA}n] \text{ ‘biting’} \\
\text{[it]} & \text{ ‘eat’ } [\text{hA}d] \text{ ‘hide’} \\
\text{[pokA]} & \text{ ‘pocket’ } [\text{wA}f] \text{ ‘wagon’} \\
\text{[bA]} & \text{ ‘back’ } [\text{bA}] \text{ ‘bag’}
\end{align*}
\]

b. Word-initial coronals realized as dorsals:

\[
\begin{align*}
\text{[kA]} & \text{ ‘toe’ } [\text{kA}] \text{ ‘tear’ } [\text{kA}b] \text{ ‘tub’} \\
\text{[gA]} & \text{ ‘done’ } [\text{gA}] \text{ ‘deer’}
\end{align*}
\]
c. Word-initial dorsals realized target appropriately:

\[
\begin{align*}
[k\text{AT}] & \quad \text{‘cut’} \\
[k\text{AP}] & \quad \text{‘cup’} \\
[k\text{OM}] & \quad \text{‘comb’} \\
[g\text{OM}] & \quad \text{‘gum’} \\
[g\text{ET}] & \quad \text{‘gate’} \\
[g\text{OUT}] & \quad \text{‘goat’}
\end{align*}
\]

Following along the lines of our proposal thus far, it should be possible to formulate an account in this case that takes advantage of markedness constraints that are freely permutable and are moreover relativised to context. A Coronal Backing error pattern that is restricted to word-initial position is suggestive of a highly ranked contextual markedness constraint formulated as in (13). This same constraint was motivated for another child from the archive, Child 126, who absolutely excluded coronal stops from initial position and systematically replaced them with different sounds under different phonological circumstances (Dinnsen and O’Connor 2001). Incidentally, Child 126’s place error pattern was classified in our archival report here under the category “Other” and not as an instance of Coronal Backing. That is, word-initial coronal stops were always replaced by a process of long-distance place assimilation or spirantisation. The point here is simply that Coronal Backing word-initially is just one possible result of the dominance of the constraint in (13). The ranking of that constraint relative to others is what yields the specific error pattern. We will return to this point in the discussion (section 5.1).

(13) Contextual markedness constraint banning Coronals:

\[*#t: \text{Avoid coronals word-initially.}\]

This contextual markedness constraint is a particular instance of the more general markedness constraint that disfavours coronals. By ranking it above an antagonistic faithfulness constraint, coronals in initial position will be eliminated. Depending on the ranking of other constraints, coronals will be replaced by a dorsal, independent of the input. This is illustrated by the tableaux in (14).

(14) Coronal Backing word-initially:

<table>
<thead>
<tr>
<th>Ranking: *#t &gt;&gt; ID[place] &gt;&gt; *t, *k</th>
</tr>
</thead>
<tbody>
<tr>
<td>/toʊ/ ‘toe’</td>
</tr>
<tr>
<td>a. toʊ</td>
</tr>
<tr>
<td>b. kou</td>
</tr>
<tr>
<td>/k\text{AP}/ ‘cup’</td>
</tr>
<tr>
<td>a. t\text{AP}</td>
</tr>
<tr>
<td>b. k\text{AP}</td>
</tr>
</tbody>
</table>

With this same ranking of constraints, we can account for the faithful realization of place in post-vocalic contexts. The tableaux in (15) illustrate this outcome. The contextual markedness constraint in this case plays no role in
the evaluation of the candidates, leaving the choice to the faithfulness constraint, which eliminates all unfaithful competitors.

(15) Coronal Backing suppressed post-vocalically:

<table>
<thead>
<tr>
<th>Context</th>
<th>Error Pattern Rank</th>
<th>Constraint Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>/it/ ‘cat’</td>
<td>*#t &gt;&gt; ID[place] &gt;&gt; *t, *k</td>
<td>#t ID[place] ♦ t ♦ k</td>
</tr>
<tr>
<td></td>
<td>a. it</td>
<td>♦ ♦ ♦</td>
</tr>
<tr>
<td></td>
<td>b. ik</td>
<td>♦ ! ♦</td>
</tr>
<tr>
<td>/bæk/ ‘back’</td>
<td>*#t ID[place] ♦ t ♦ k</td>
<td>♦ ♦ ♦</td>
</tr>
<tr>
<td></td>
<td>a. bæt</td>
<td>♦ ♦ ♦</td>
</tr>
<tr>
<td></td>
<td>b. bæk</td>
<td>♦ ♦ ♦</td>
</tr>
</tbody>
</table>

On the basis of these cases, it becomes apparent that Coronal Backing and Velar Fronting are indeed independent opposing processes that may or may not occur, and that may or may not be restricted to word-initial position. Table 2 summarizes the attested possibilities with the associated constraint rankings. The Velar Fronting error patterns (a and b) are well documented in the literature (Chiat 1983; Stemberger and Stoel-Gammon 1991; Bernhardt and Stoel-Gammon 1996; Stoel-Gammon 1996; Inkelas and Rose 2003). The Coronal Backing error patterns (c and d) have been the focus of this article and are admittedly less well documented (Stemberger and Stoel-Gammon 1991; Bernhardt and Stoel-Gammon 1996).

Table 2: Typology

<table>
<thead>
<tr>
<th>Error Pattern</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Context-free Velar Fronting</td>
<td>*k &gt;&gt; ID[place] &gt;&gt; *t</td>
</tr>
<tr>
<td>b. Word-initial Velar Fronting</td>
<td>*#k &gt;&gt; ID[place] &gt;&gt; *k, *t</td>
</tr>
<tr>
<td>c. Context-free Coronal Backing</td>
<td>*t &gt;&gt; ID[place] &gt;&gt; *k</td>
</tr>
<tr>
<td>d. Word-initial Coronal Backing</td>
<td>*#t &gt;&gt; ID[place] &gt;&gt; *t, *k</td>
</tr>
<tr>
<td>e. No Coronal Backing or Velar Fronting</td>
<td>ID[place] &gt;&gt; *k, *t</td>
</tr>
</tbody>
</table>

5. DISCUSSION

In this section, we take up three general issues that emerge from our results and analyses. The first relates to the statistical disparity that obtains in the occurrence of Coronal Backing versus Velar Fronting. We highlight a promising first step toward a solution to this problem. The second issue involves the observed disparity in what constitutes a prominent context for children versus adults. Finally, the third issue relates to the difference, if any, between normally developing and disordered phonologies, the latter of which have been the focus of this article.
5.1. Accounting for the statistical disparities

The case studies of Child LP13 and Child LP76 were singled out from the archive for discussion because of the challenges they pose for claims about the markedness of place features and the markedness of contexts for those features. The children’s inventories and/or their substitution patterns involved the exclusion of presumably unmarked coronals in one or more contexts, which were moreover replaced by more marked dorsals. The Coronal Backing error pattern, whether context-free or positionally restricted, is admittedly less common than Velar Fronting, but possibly no less common than the seemingly anomalous gapped inventories of Yellowknife Chipewyan or Hawaiian. The facts of these case studies when combined with the archival study and the available case studies from the published literature on acquisition reveal that the full range of logical possibilities seems to occur. As such, these acquisition facts are not consistent with other asymmetries that are typically taken as indicative of a markedness scale or an implicational universal.

The relative markedness of place features has also been questioned on the basis of phenomena from fully developed languages (e.g., Trigo 1988; McCarthy and Taub 1992; Rice 1996; Rice and Causley 1998; Hume and Tserdanelis 2002). Our solution here has been to abandon fixed rankings and stringency relations among place-referring constraints and instead to adopt independent, freely permutable place constraints. While such an approach can provide for the attested possibilities yielding a factorial typology, it cannot account for the relative frequency with which these error patterns occur. This is an acknowledged limitation of Optimality Theory generally (McCarthy 2002). As we saw from the archival study, the fact is that Coronal Backing is much less common than Velar Fronting. It may well be that the place markedness scale is only a near-universal and simply reflects a statistical tendency, not a law.

A promising approach for the characterization of near-universals of this type has been advanced by Coetzee (2002) in the form of “Preference Constraints”. This new family of constraints augments the universal constraint set but differs in at least one important respect from conventional markedness and faithfulness constraints. The difference is that a preference constraint is violated by an output candidate if and only if that candidate is favoured by a particular ranking of other constraints. Preference constraints recognize the general cross-linguistic validity of markedness scales, but do so without demanding strict compliance with a fixed ranking among the constraints relevant to that scale. Instead, preference constraints help to achieve the expected result of those scales in most languages by assigning an extra violation mark to output candidates that would be favoured by a constraint ranking that is contrary to the typical markedness scale. Extending this approach to the place markedness scale, the preferred ranking of the markedness constraints would be for *k to outrank *t, favouring a coronal output over a dorsal. The newly proposed and independent place preference constraint might be formulated as in (16).
(16) Place preference constraint:

\[ [*k > *t]: \text{Assign a violation mark to a dorsal when it is favoured by the ranking of *t over *k.} \]

When the two independent markedness constraints are ranked in accord with the demands of the place preference constraint, the preference constraint exercises no force regardless of how it is ranked relative to the markedness constraints. The place preference constraint assigns no violation marks to any candidates in this instance because the ranking of the markedness constraints accords with the preferred ranking and would in the typical case yield a coronal output. However, in a different case where the two markedness constraints happen to be reversed in their ranking with *t ranked above *k, a dorsal output would in principle be favoured, and it is that result that calls into play the place preference constraint. It is important to keep in mind that the dominance of the preference constraint does not necessarily influence the ultimate outcome. That is, the preference constraint can only exercise some force if it is ranked high enough to override or undo the non-preferred ranking of the markedness constraints. For example, in the case where the preference constraint is ranked above *t, the added violation mark assigned by the preference constraint to the candidate with a dorsal causes the dorsal to lose out to the candidate with a coronal. This is illustrated by the tableau in (17) with a coronal input and the non-preferred ranking of *t over *k. The dominance of the preference constraint results in a fatal violation mark being assigned to the candidate with a dorsal. Thus, even though the non-preferred ranking of the markedness constraints would have favoured a marked output, the greater demand to comply with the preference constraint negated that effect.

(17) Place preference constraint overrides markedness scale violation:

\[
\text{Ranking: } [*k > *t] >> *t >> *k
\]

Consider a different case where *t again outranks *k. That non-preferred ranking calls into play the place preference constraint as before. However, if the preference constraint were ranked below *t, then the seemingly more marked dorsal candidate would be permitted to survive as optimal. This is illustrated by the tableau in (18) for an input coronal. The higher ranking of *t assigns a fatal violation mark to the coronal candidate. In turn, the lower ranking of the preference constraint in this instance renders its violation ineffectual and thus permits violations of the place markedness scale.
Markedness scale violation wins out:

\[
\text{Ranking: } ^*t >> [k >> ^*t] >> ^*k
\]

Table 3 spells out the 24 logically possible constraint rankings assuming the two context-free markedness constraints (*t and *k), the place preference constraint, and a generalized faithfulness constraint. Three distinct empirical results are predicted to follow from these various hierarchies. The first set of 11 rankings (46%) in (a) all converge on a coronal output, independent of the input. The next 6 rankings (25%) in (b) yield a dorsal, independent of the input. Finally, the remaining 7 rankings (29% of the total rankings) in (c) yield fully faithful outputs for input coronals and dorsals.

The probability that a non-preferred constraint ranking will actually result in a markedness scale reversal is lessened (but not precluded) by the more limited number of available constraint rankings that are consistent with that result, that is, only those where *t dominates both *k and the place preference constraint. The prediction of preference constraints in this instance is that we might expect Coronal Backing to occur approximately 25% of the time. Our archival results revealed that Coronal Backing occurred in only 4% of the cases. The predicted and observed results from our archival study were somewhat closer in the case of Velar Fronting: predicted 46% and observed 39%. We readily acknowledge that preference constraints may not derive the precise probability values for the occurrence of Velar Fronting versus Coronal Backing, but they at least begin to approach a generalization that expresses distinct trends. The difference between the predicted and observed results for fully faithful outputs (predicted 29%, observed 53%) is diminished when it is recognized that the children from our archive were acquiring English, which requires fully faithful outputs. The target language should obviously bias the outcome along the lines of the observed results when target faithfulness is involved.

It is important to keep in mind as well that we have been focussing on the incidence of an error pattern (e.g., Velar Fronting or Coronal Backing). However, the available constraint rankings do not necessarily correlate with a specific error
Table 3: Logically possible constraint rankings and predictions

<table>
<thead>
<tr>
<th>Rankings</th>
<th>Empirical Result</th>
<th>Predicted</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. *k &gt;&gt; FAITH &gt;&gt; *t &gt;&gt; [*k &gt; *t]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*k &gt;&gt; FAITH &gt;&gt; [*k &gt; *t] &gt;&gt; *t</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*k &gt;&gt; *t &gt;&gt; FAITH &gt;&gt; [*k &gt; *t]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*k &gt;&gt; [*k &gt; *t] &gt;&gt; FAITH &gt;&gt; *t</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*k &gt;&gt; [*k &gt; *t] &gt;&gt; *t &gt;&gt; FAITH</td>
<td>Velar Fronting</td>
<td>46%</td>
<td>39%</td>
</tr>
<tr>
<td>[*k &gt; *t] &gt;&gt; FAITH &gt;&gt; *t &gt;&gt; *k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[*k &gt; *t] &gt;&gt; *t &gt;&gt; FAITH &gt;&gt; *k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[*k &gt; *t] &gt;&gt; *t &gt;&gt; *k &gt;&gt; FAITH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[*k &gt; *t] &gt;&gt; *k &gt;&gt; *t &gt;&gt; FAITH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. *t &gt;&gt; FAITH &gt;&gt; *k &gt;&gt; [*k &gt; *t]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*t &gt;&gt; FAITH &gt;&gt; [*k &gt; *t] &gt;&gt; *k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*t &gt;&gt; *k &gt;&gt; FAITH &gt;&gt; [*k &gt; *t]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*t &gt;&gt; [*k &gt; *t] &gt;&gt; *k &gt;&gt; FAITH</td>
<td>Coronal Backing</td>
<td>25%</td>
<td>4%</td>
</tr>
<tr>
<td>*t &gt;&gt; [*k &gt; *t] &gt;&gt; *k &gt;&gt; FAITH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*t &gt;&gt; [*k &gt; *t] &gt;&gt; *k &gt;&gt; FAITH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. FAITH &gt;&gt; *t &gt;&gt; *k &gt;&gt; [*k &gt; *t]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAITH &gt;&gt; *t &gt;&gt; [*k &gt; *t] &gt;&gt; *k</td>
<td>No Coronal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAITH &gt;&gt; *k &gt;&gt; *t &gt;&gt; [*k &gt; *t]</td>
<td>Backing or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAITH &gt;&gt; [*k &gt; *t] &gt;&gt; *t &gt;&gt; *k</td>
<td>Velar Fronting</td>
<td>29%</td>
<td>53%</td>
</tr>
<tr>
<td>FAITH &gt;&gt; [*k &gt; *t] &gt;&gt; *k &gt;&gt; *t</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[*k &gt; *t] &gt;&gt; FAITH &gt;&gt; *k &gt;&gt; *t</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pattern. These same constraint rankings would yield different error patterns with other constraints interspersed in the hierarchy. Thus, while the dominance of \*t can result in Coronal Backing, it can also result in other error patterns depending on the remainder of the hierarchy. This was briefly noted earlier with regard to Child 126, who did not exhibit Coronal Backing but still required the non-preferred ranking of the place constraints (Dinnsen and O’Connor 2001). Consequently, the sum total of those error patterns from the Coronal Backing category (4%) and the “Other” category (5%) in Table 1 may more closely correspond with the proportion of those rankings where \*t is dominant. Of course, the other possibility is that the statistical disparity between the observed and predicted results is an indication that yet other constraints may need to be interleaved into the hierarchy.

Preference constraints admittedly undermine to some extent assumptions about coronal unmarkedness. However, this seems appropriate given the empirical findings reported here and in the literature on fully developed languages. On the one hand, with fixed rankings and no preference constraints, no marked-
ness reversals are predicted. On the other hand, other approaches that allow language-specific defaults predict a greater incidence of markedness reversals. For example, underspecification accounts that allow language-specific defaults for place features would predict an equal probability of occurrence of a coronal or a dorsal as a substitute (e.g., Archangeli and Pulleyblank 1994; Rice 1996). We have seen, however, that these patterns do not occur with equal probability. Preference constraints at least begin to give coronals a statistical advantage for being unmarked while only sparingly allowing dorsals to be unmarked at other times.

Many important issues surrounding preference constraints remain to be resolved, not the least of which relate to acquisition concerns, for example, determining the default ranking of preference constraints and the nature of the evidence needed to motivate a reranking of the constraints.

5.2. Accounting for the child-adult disparity

The case of Child LP76 with the word-initial Coronal Backing error pattern served as a particular instantiation of a more general and pervasive problem that challenges a different scale relating to context. On the basis of evidence from fully developed languages, word-initial position is judged to be more prominent or perceptually more salient relative to other contexts (Beckman 1998; Smith 2002). A consequence of that scale is that word-initial position should be a preferred context for the preservation of place distinctions. However, children’s place substitution error patterns that are restricted to word-initial position (whether Coronal Backing or Velar Fronting) violate that scale by merging a place contrast in a presumably strong context while preserving it elsewhere. Our solution in this instance was to permit a fuller set of constraints and constraint rankings. Specifically, the markedness constraints were relativized to word-initial context and were freely permutable with the other constraints. While this can account for the acquisition facts, it cannot explain the presumed non-occurrence of such effects in fully developed languages (Stoel-Gammon 1996; Inkelas and Rose 2003).

One possibility entertained by Dinnsen and Farris (2003a) as a partial solution to this paradox is to appeal to a developmental shift in what serves as a prominent context. The idea is that in early stages of acquisition, the default is for children to attend more to utterance-final or word-final position (e.g., Slobin 1973). The prominence of final position in early development renders other contexts less salient during that time frame and facilitates the acquisition of contrasts in final position first. Later, in the course of development, other contexts become more salient, in accord with standard assumptions about what constitutes a strong context in fully developed languages. This shift in prominence may be motivated in part by changes in the size of the lexicon with the addition of new words and the associated reorganization of the lexicon (Walley, Metsala, and Garlock 2003). As further support for the idea that contexts are treated differently by children and adults, metalinguistic tasks reveal children’s greater reliance on the rhyme of
the syllable (as opposed to the onset), especially in similarity judgments (Treiman and Zukowski 1991). Brooks and MacWhinney (2000) also document a developmental shift in prominence, showing that rhymes are more salient in the early stages of acquisition while other contexts (e.g., onsets and word-initial position) become more salient only later in development. Additional empirical and theoretical support, derived from cross-linguistic and developmental evidence, shows that onset structures, such as true clusters (e.g., [kl]), depend on the occurrence of coda consonants (Leó and Prinz 1996; Baertsch 2002). Thus, the dependence of onset clusters on rhyme structure may be a remnant of the early prominence of rhymes.

The suggestion that there is a developmental shift in the prominence of certain contexts has the consequence for Optimality Theory that the universal constraint set can remain more limited in the number and type of constraints it permits and would be the same for children and adults. Instead of admitting child-specific constraints into the universal constraint set, the proposal is that there would be one common set of constraints for child and adult grammars where constraints that might have been formulated in terms of a specific strong context such as a syllable onset for adult grammars would under Dinnsen and Farris’s proposal be formulated simply in terms of prominence of a syllable margin. The instantiation of that general constraint would be for onsets to serve as prominent contexts for adults but for codas to serve as prominent contexts for children, at least for those learners who allow codas in their outputs. The choice of which context is prominent would be determined by other factors, for example lexical frequency, neighbourhood density, and processing demands. A relatively small lexicon with sparse neighbourhood structure can rely on the default prominence of final position. As the lexicon increases in size and neighbourhood density, there are greater demands on processing, which force other structures to take on greater prominence.

The findings presented in this article by no means depend on the validity of Dinnsen and Farris’s proposal. Their proposal is alluded to as just one possible approach for dealing with the different behaviour of context in child versus adult grammars. The ultimate promise of any of these suggestions will depend on additional studies that examine other markedness scales and attempt to reconcile differences between developing and fully developed languages.

5.3. Normal versus disordered phonologies

Velar Fronting is a common, well-documented error pattern in both normal and disordered phonologies (Stemberger and Stoel-Gammon 1991; Bernhardt and Stoel-Gammon 1996). While the contextual restrictions of Velar Fronting are counter to observed cross-linguistic patterns of positional effects, the error pattern of Coronal Backing is more problematic, although much less common. The evidence presented in this article relating to this error pattern has come from
children with phonological delays. In an attempt to preserve standard assumptions about place markedness scales, some might find it tempting to discount these cases as somehow outside the realm of linguistic theory. While such a tactic is obviously self-serving, it is also unclear on what basis these cases could be set aside given that all of the children from the archive scored within normal limits on all tests of hearing, oral-motor skills, and receptive and expressive language. Additionally, many of the phenomena exhibited by children with phonological delays are similar to those of their younger, typically developing peers (Bernhardt and Stoel-Gammon 1996). The fact remains that normal development and fully developed languages exhibit some of the same inventory restrictions and substitution patterns that we have documented here for atypical development. For example, Bernhardt and Stoel-Gammon (1996) examined consonantal place distinctions of 52 normally developing children (mean age of 1;3) and found that six (approximately 12%) excluded coronal stops from their inventories. This is a slightly greater incidence than was observed in our archive. Stemberger and Stoel-Gammon (1991) also report that, in both adult speech errors and normal acquisition, Coronal Backing does occur, although significantly less often than Velar Fronting. Ultimately, there is little evidence, if any, that we can point to that would distinguish normally developing phonologies from those of children with phonological delays. Even those so-called “unusual error patterns” that are often equated with a deviant or truly disordered phonology (e.g., Camarata and Gandour 1984; Leonard and Brown 1984) have been shown to follow from general principles of grammar (Dinnsen 1999; Dinnsen and Farris 2003b). Our own view has been that the study of phonological delays can sometimes afford even greater insights into acquisition generally, especially given that the children are somewhat older and can submit to rigorous testing in controlled experimental settings.

6. Conclusion

In conclusion, this article has examined two markedness scales, one that maintains that dorsals are more marked than coronals and another that maintains that word-initial position is a strong context that preserves (and even enhances) place distinctions relative to other contexts. Evidence about inventory structure and substitution patterns was brought to bear from a large-scale cross-sectional archival study of 211 children with phonological delays. The full range of logical possibilities was found to occur with regard to inventory structure; that is, some children included both coronals and dorsals in their inventories, others included coronals but not dorsals, and yet others included dorsals but not coronals. In terms of the children’s substitution patterns, dorsals were replaced by coronals (Velar Fronting) in a large proportion of the cases. However, a small proportion of the children replaced coronals with dorsals (Coronal Backing). The inventories with dorsals but not coronals and the error pattern of Coronal Backing was shown to pose the biggest problem for claims about coronal unmarkedness and theoretical accounts
of the facts. It was proposed that fixed constraint rankings and stringency relations among constraints be rejected in favour of independent and freely permutable place-referring constraints. We have focussed specifically on optimality-theoretic accounts of these facts, but they bear on other approaches as well.

In terms of context, it was found that some children merge place distinctions in the presumably strong context of word-initial position while preserving those distinctions in other contexts. These facts run counter to observed context effects in fully developed languages. It was proposed that the place-referring constraints needed to be relativised to word-initial position, at least for developing phonologies.

To deal with the statistical disparity in the occurrence of Coronal Backing and Velar Fronting, appeal was made to a new family of constraints, preference constraints, which impose a statistical bias for hierarchies that comply with coronal unmarkedness (Coetzee 2002). The disparity between child and adult phonologies with regard to context effects was addressed by entertaining the possibility that there is a developmental shift in prominence that is triggered by changes in the size and structure of the lexicon (Dinnsen and Farris 2003a).

REFERENCES


