Contrast and the interpretation of empty vowels in Pasiego*

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I. Introduction

A. The problem

In recent work in phonology, it has been argued that features that are absent underlyingly cannot be filled in in the phonological component of the grammar (Avery & Rice 1989: 184). This characteristic is identified as persistent underspecification. In this paper, I explore the mechanism(s) by which underspecified vowels are interpreted phonetically if they do not receive features.

The inventory in (1) offers an illustration of the problem: suppose that a five-vowel inventory has the following phonological representations (see Dyck 1993 and §II of this paper for arguments).

(1) 5-vowel system:

/ɪ/ /e/ /æ/ /ɛ/ /u/  
[high] [low] [labial] [high, labial]

If no spreading rules apply, a vowel such as /e/ in (1) may exit the phonology with no features, a case of persistent underspecification. The question I will address in this paper is how the vowel /e/ in particular is realized for place of articulation. I use data from Pasiego, a peninsular Spanish dialect (see Penny 1969), to inform my discussion.

The paper proceeds as follows: In §II, I argue that mid vowels have no height features in Pasiego, in order to substantiate the claim that /e/ is empty of features. In §III, I present evidence to show that the mid vowels in Pasiego pattern like persistently underspecified segments, i.e. that they are realized in a variable manner. In §IV, I argue that the mid vowel variation in Pasiego occurs in predictable (metrical) contexts, and then propose that context-sensitive rules derive this variation. Finally, in §V, I synthesize the findings of the previous sections, outlining a phonetic interpretation model which accounts for the variable behaviour of Pasiego mid vowels. In this model, enhancement rules apply or fail to apply to enhance the representations of empty vowels.

B. Theoretical background

I make the following assumptions concerning vowel feature geometry. First, following Clements (1989) and others, I assume that vowels have a place node for the place features, and an aperture node for height features, as illustrated in (2).

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1 Steriade (to appear) also assumes persistent underspecification, but unlike Avery & Rice (1989), Steriade assumes that underspecification persists into the phonetic component.
(2) Vowel feature geometry

\[
\text{Root} \quad \underline{\text{Place}} \quad \underline{\text{Aperture}}
\]

[labial] [coronal] [low] [high]

I follow Hume (1992) in assuming that front vowels do not always have [coronal] phonetically. However, I assume that front vowels do not always have [coronal] underlingly: I adopt Rose (1993) and Walker (1993)'s arguments that [coronal] does not appear in the underlying representations of front vowels unless forced by contrasts between front unrounded and central vowels of the same height.

I assume, following general markedness considerations (cf. Chomsky & Halle 1968), that [labial] is an intrinsic feature of back vowels. The feature [labial] is thus different from [coronal]; in the unmarked case, [labial] always appears in underlying representations; however, [coronal] only appears if forced to.\(^2\)

As discussed below, I also assume that the height feature [low] distinguishes low from non-low vowels, and that the feature [high] does not appear in vowel representations unless forced to do so in order to contrast sounds in more complex inventories (see Dyck (1992) for further arguments).

Finally, I assume that a vowel representation with no height or place features is phonetically realized as schwa [ə] (cf. Clements (1991: 80), Steriade (to appear), Wu (1994)).

I assume the model of underspecification known as Modified Contrastive Underspecification (MCS), as developed in Avery and Rice (1989), Rice (1993), Rice and Avery (1993).\(^3\) MCS claims 1) that there is a monotonic algorithm for adding contrasts to vowel inventories, and 2) that as contrasts are elaborated within inventories, features are added only in order to express these contrasts. I assume, based on evidence from Spanish and Italian dialects discussed in Dyck (1992) that the algorithm for adding height contrasts to inventories distinguishes the following:

(3) Contrastive determination of vowel height:

a. low vs. unmarked vowels
b. high vs. unmarked vowels

This algorithm predicts the representations shown in (4) for various vowel systems.

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\(^2\) Dependency phonology essentially assumes that [labial] is unmarked for back vowels and that [coronal] is unmarked for front vowels. I do not make the latter assumption. Instead, I assume that back vowels are [labial] in the unmarked case, while in the unmarked case, front vowels are non-labial, rather than [coronal].

\(^3\) Cf. also Steriade (1987) and Mester and Itô (1989) for discussion of contrastive (under)specification.
(4) Some vowel inventories of Spanish and Italian dialects, determined on the basis of Modified Contrastive Specification:

a. 3-vowel inventory
(Mirandés final vowels, Catalan reduced vowels)  
\[ \begin{array}{c|c|c|c} \hline
  & i & a & u \\ \hline
  & \text{low} & \text{labial} \\ \hline
\end{array} \]

b. an equivalent 3-vowel inventory
(Standard Spanish final vowels)  
\[ \begin{array}{c|c|c|c} \hline
  & e & a & o \\ \hline
  & \text{low} & \text{labial} \\ \hline
\end{array} \]

c. 5-vowel inventory
(Standard Spanish)  
\[ \begin{array}{c|c|c|c|c} \hline
  & i & e & a & o & u \\ \hline
  & \text{high} & \text{low} & \text{labial} & \text{high} \text{labial} \\ \hline
\end{array} \]

d. 4-vowel inventory
(Pasiego (Spanish) final vowels)  
\[ \begin{array}{c|c|c|c|c} \hline
  & a & a & o & u \\ \hline
  & \text{low} & \text{labial} & \text{high} \text{labial} \\ \hline
\end{array} \]

e. 4-vowel inventory
(Lena (Spanish) final vowels)  
\[ \begin{array}{c|c|c|c|c} \hline
  & e & a & o & u \\ \hline
  & \text{low} & \text{labial} & \text{high} \text{labial} \\ \hline
\end{array} \]

f. 4-vowel inventory
(Cabranes (Spanish) final vowels)  
\[ \begin{array}{c|c|c|c|c} \hline
  & i & e & a & u \\ \hline
  & \text{high} & \text{low} & \text{labial} \\ \hline
\end{array} \]

g. 4-vowel inventory
(Calvello (Italian))  
\[ \begin{array}{c|c|c|c|c} \hline
  & i & e & a & o \\ \hline
  & \text{high} & \text{low} & \text{labial} \\ \hline
\end{array} \]

In (4.a) and (4.b), only two vowel heights are contrasted; to express this contrast, MCS employs the distinction between [low] vs. unmarked. (The unmarked vowels are phonetically realized as high vowels in (4.a), and as mid vowels in (4.b).)

In (4.c), on the other hand, two non-low vowel heights are contrasted; the contrast between [high] vs. unmarked forces the presence of [high] on the high vowels; the mid vowels, however, remain without height features because their heightless representations are minimally distinct from the low and high vowels.

In (4.d) and (4.e), which represent asymmetrical systems, a [high] vs. unmarked contrast only exists in the back vowel region. For this reason, there is only one phonologically high vowel, which is realized as [u] in (4.d) and (4.e). In the front vowel region in (4.d) and (4.e), there is no [high] vs. unmarked contrast, and therefore no phonologically high front vowel. The non-high, non-low front vowel is realized phonetically as [e] or [e], depending on the dialect in question.

In contrast to (4.d) and (4.e), (4.f) and (4.g) illustrate asymmetrical inventories in which there is a [high] vs. unmarked contrast only in the front vowel region; the sole phonologically high vowel (realized as [i]) is in the front region. In the back vowel region, on the other hand, there is no [high] vs. unmarked contrast, and therefore no phonologically high back vowel. The non-high, non-low back vowel is phonetically realized as [u] or as [o], depending on the language in question.

Assuming Modified Contrastive Specification as in (4), the problem of phonetic interpretation illustrated in (5) arises. Example (5) is essentially a restatement of (4); (however, the fourth column is new and will be discussed below).
(5) The interpretation of representations in Spanish dialects:

<table>
<thead>
<tr>
<th>height</th>
<th>place</th>
<th>instantiation</th>
<th>notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>φ</td>
<td>a (3.a-g)</td>
<td>/A/</td>
</tr>
<tr>
<td>high</td>
<td>φ</td>
<td>i (3.a,c,f,g)</td>
<td>/I/</td>
</tr>
<tr>
<td>high</td>
<td>labial</td>
<td>u (3.c,d,e)</td>
<td>/U/</td>
</tr>
<tr>
<td>φ</td>
<td>labial</td>
<td>o (3.b,c,d,e,f)</td>
<td>/O/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>u (3.a,f)</td>
<td></td>
</tr>
<tr>
<td>φ</td>
<td>φ</td>
<td>e (3.b,c,f,g)</td>
<td>/ø/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a (3.d)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>i (3.a)</td>
<td></td>
</tr>
</tbody>
</table>

Example (5) shows that when vowels are specified for height features, they have one uniform instantiation—[a], [i], and [u]—in the Spanish and Italian dialects presented in (4). On the other hand when vowels have no height features, their phonetic instantiation varies. For example, the representation [labial] is realized as either [o] or [u], and the empty vowel representation is realized as [i], [a], or [e]. The task of this paper is to show that the variation in (5) is principled and limited.

Before turning to the next section, I introduce a convention which will be used for the remainder of this paper. As shown in the fourth column of (5), the symbol /A/ designates the representation [low, φ]—i.e. a vowel whose height is specified as [low] and which is unmarked for place; /I/ designates [high, φ]; /U/ denotes [high, labial]; /O/ designates [φ, labial], and /ø/ designates the empty vowel, [φ, φ]. This final vowel is equivalent to /e/ in (1) and (4).

II. Evidence that the mid vowels are empty in Pasiego

In this section, I turn to my case study of Pasiego, and briefly present evidence that the mid vowels in Pasiego have no height features. I argue for this point in order to show that Pasiego displays the problem of persistent underspecification discussed in the introduction.

The evidence for the empty representations of mid vowels in Pasiego comes from the process of metaphor, which is illustrated in (6).

(6) Pasiego metaphor (centralization/laxing not shown):†

mid vowels:

<table>
<thead>
<tr>
<th>no metaphor</th>
<th>metaphor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. glórdi</td>
<td>glúrdi</td>
</tr>
<tr>
<td></td>
<td>‘fat (neuter); fat (masculine)’</td>
</tr>
<tr>
<td>b. konélxos</td>
<td>kun[i]xu</td>
</tr>
<tr>
<td></td>
<td>‘rabbits, rabbit’</td>
</tr>
</tbody>
</table>

vs.

high vowels:

<table>
<thead>
<tr>
<th>no metaphor</th>
<th>metaphor</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. luž m[i]yos</td>
<td>il m[i]yu</td>
</tr>
<tr>
<td></td>
<td>‘mine (pl.), mine (sg.)’</td>
</tr>
<tr>
<td>d. bjhülda</td>
<td>bjhüdu</td>
</tr>
<tr>
<td></td>
<td>‘widow, widower’</td>
</tr>
</tbody>
</table>

Example (6) shows that the target mid vowels (in square brackets) raise to high under the influence of a final high [-u] (6.a,b), and that high vowels are unaffected (6.c,d) (thus establishing the rule as raising).

One possible account—which I will adopt—for the patterning in (6) is a rule that spreads [high] to the mid vowels.\(^5\) The outcome of the spreading rule is shown in (7) and (8).

(7) A spreading analysis of metaphorony (abstracting away from place features):

- Underlying /I,U/
- Surface /i, u/
- Metaphonized to /i, u/
- Surface /e,o/ (high)
- Underlying /A/
- Surface /a/ (low)

As shown in (7), the mid vowels that undergo metaphorony receive the feature [high] by spreading, and as a result they neutralize with high vowels.

The spreading rule that I argue for is illustrated in (8).

(8) A spreading analysis of metaphorony, (including metrical information):

- tonic X
- final X
- ...
- Pl Ap

As shown in (8) the feature [high] spreads from a trigger that occurs in metrically weak position (known as 'final' position in the Spanish literature) and targets mid vowels in metrically strong position (known as the 'tonic' or 'main-word-stress' position). I include metrical structure for reasons discussed below.

I will argue for the analysis in (7) and (8) based on certain facts about the metrically-conditioned distribution of vowels in Pasiego (and in all Spanish dialects). I introduce these facts below.

As noted in Green (1988: 93-99) and Penny (1991: 47-51), Spanish vowels are not evenly distributed throughout the word (these observations hold of Pasiego as well). As shown in (9), the greatest number of vowels and vocalic contrasts occurs in tonic (main-word-stress or 'ton') position. In pretonic (pre-main-word-stress or 'pre') position, a reduced set of vowels can occur: The vowels represented as 'je' and 'e' neutralize to 'e' in pretonic position, while the vowels 'we' and 'o' neutralize to 'o' on pretonic position.\(^6\) In

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\(^6\) This is a somewhat simplified picture which captures the fact that the diphthongs [je] and [we] neutralize with monophthongs in pretonic position. For discussion of the problem of diphthong/vowel alternations in Spanish, see, among others, García-Bellido (1986), and Malkiel (1984 a,b).
final ('fin') position in Pasiego, on the other hand, there is an even smaller subset of vowels, consisting of 'e', 'a', 'o', and 'u'.

(9) **Vowel distribution in the Pasiego word (pretonic, tonic, and final vowels):**

<table>
<thead>
<tr>
<th></th>
<th>pre</th>
<th>ton</th>
<th>fin</th>
</tr>
</thead>
<tbody>
<tr>
<td>l</td>
<td>l</td>
<td>l</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>i</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>e</td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>je</td>
<td>a</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>o</td>
<td>we</td>
<td>u</td>
<td></td>
</tr>
<tr>
<td>u</td>
<td>u</td>
<td>u</td>
<td></td>
</tr>
</tbody>
</table>

Example (9) shows that in Pasiego, metrically strong position (i.e. tonic position) allows a greater range of phonological contrasts than metrically weak positions (i.e. pretonic and final position). This can be thought of in terms of phonological information: metrically strong position licences a greater range of features than weak positions.

Given that the metrically strong position licences more contrasts than weak positions, one might expect to find relationships between vowels in the two positions. In particular, it would not be surprising to find the following situation:

(10) **Posited relationships between metrically strong and weak vowels:**

<table>
<thead>
<tr>
<th>Metrically Strong Position</th>
<th>Metrically Weak Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. more specified representations</td>
<td>less specified representations</td>
</tr>
<tr>
<td>b. equally specified representations</td>
<td>equally specified representations</td>
</tr>
<tr>
<td>c. *less specified representations</td>
<td>*more specified representations</td>
</tr>
</tbody>
</table>

One might expect the relationship between metrically strong position and metrically weak position to be such that in metrically strong position, vowel representations would be either more specified than those in weak position, or equally as specified as those in weak position. However, one should also expect to be disallowed a relationship in which metrically strong position contains less specified representations than metrically weak position. The data in (9) illustrates that (10.c) is strongly disfavoured in Pasiego.

The configuration in (10.c) may be seen as an imbalance that needs to be redressed. From a functional standpoint, the spreading rule in (8) accomplishes this purpose: as shown in (8), the structural description of metaphony refers to the disallowed configuration in which the vowel in tonic (metrically strong) position is less specified than the vowel in final (metrically weak) position. The rule of metaphony redresses this problem by creating a relationship in which the vowel in metrically strong position becomes equally as specified as the vowel in metrically weak position.

The functional role fulfilled by the spreading analysis in (8) argues in favour of spreading over an alternative delinking analysis: Delinking analyses require that mid vowels have fuller representations than high vowels. This is illustrated in (11), which describes a possible delinking analysis.
(11) Delinking analysis of metaphony:

a. /\/  /\  /A/  /O/  /U/
   high high low high high
   low low round round

b. /\/  /\  /A/  /O/  /U/
   high high low high high
   low low round round

Essentially, as shown in (11.a), the height representation for high vowels (in this example, [high]) must be in a subset relationship with the representation of mid vowels (in this example, [high, low]) in a delinking analysis. As shown in (11.b), delinking of [low] from the representations of mid vowels causes the mid vowels to neutralize with the high vowels.

However, the type of delinking analysis illustrated in (11) is not compatible with the facts of vowel distribution in Pasiego, shown in (9). In particular, the attractive functional explanation—which is compatible with the spreading analysis in (7) and (8)—is not compatible with the delinking analysis in (11). This is because the delinking analysis results in less complexity in tonic position, where we have no reason to believe that less complexity is required. For this reason, I adopt the spreading analysis in (8).

To summarize, I have provided evidence that a spreading analysis of metaphony is consistent with the facts of Pasiego vowel distribution. The spreading analysis in turn is consistent only with the assumption that the mid vowels in Pasiego are empty of height features.

III. Other evidence for underlyingly empty mid vowels: variable mid vowels in Pasiego

In this section, I show that Pasiego mid vowels behave in the manner of permanently underspecified segments. As discussed in Steriade (to appear), and as argued by Dependency phonologists (eg. van der Hulst 1989), I assume that underspecified segments may have more variable phonetic instantiations than specified segments. I argue that Pasiego mid vowels, which are not specified for height features, are more phonetically variable than the peripheral vowels /\,A, U/, which are specified for height features. My ultimate point is that Pasiego empty mid vowels have the type of permanent underspecification that permits variability in surface realization.

A. Data from the realization of mid vowels in Pasiego

In order to show that mid vowels in Pasiego are phonetically variable, I discuss what Penny (1969) describes as the rule-driven behaviour of Pasiego mid vowels. Then I

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7 I use the features [high] and [low] to characterize mid vowels in order to be consistent with the rest of this paper. This usage is parallel to the Dependency Phonology practice of combining elements. It is also consistent with Goad (1992a), in which the features for mid vowels are the intersecting set of features required for high and low vowels: in Goad's geometry, high vowels have a 'V₀' node, low vowels have the feature [low], dominated by the feature [open], which is in turn dominated by the 'V₀' node; mid vowels have the feature [open], dominated by the 'V₀' node. Thus mid vowels in Goad's framework have something in common with high vowels (namely 'V₀') and something in common with low vowels (namely the feature [open]).

introduce the variable behaviour also described in Penny (1969). In §IV, I argue that this variable behaviour is rule-driven as well.

1. The phonetic inventory and regular behaviour of Pasiego vowels

The rule-driven behaviour of Pasiego vowels is summarized in (12) to (14). The transcription used, largely faithful to Penny 1969, is shown in (12).9,10

(12) Pasiego transcription

\[
\begin{array}{c|c}
\text{i} & \text{u} \\
\text{u} & \\
\text{e} & \text{a} & \text{o}
\end{array}
\]

\[
\begin{array}{l|l}
\rightarrow & \text{high front vowel} \\
\rightarrow & \text{mid front vowel} \\
\rightarrow & \text{raised, fronted schwa; occurs in word-final position} \\
\rightarrow & \text{slightly raised, fronted schwa} \\
\rightarrow & \text{schwa} \\
\rightarrow & \text{low back vowel} \\
\rightarrow & \text{raised lax variant of /a/, occurring in word-final position} \\
\rightarrow & \text{high back rounded vowel} \\
\rightarrow & \text{lowered high back rounded vowel (an allophone of /o/)} \\
\rightarrow & \text{raised, mid back rounded vowel (an allophone of /o/)} \\
\rightarrow & \text{greatly centralized variant of /o/}
\end{array}
\]

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9 Differences between my font and Penny (1969)'s are noted below:

<table>
<thead>
<tr>
<th>Penny</th>
<th>Mine</th>
</tr>
</thead>
<tbody>
<tr>
<td>[i]</td>
<td>[i:]</td>
</tr>
<tr>
<td>[f]</td>
<td>[f]</td>
</tr>
<tr>
<td>superscript letter</td>
<td>letter is enclosed in parentheses ( )</td>
</tr>
<tr>
<td>line through the top of a letter [b]</td>
<td>the line appears in the body of the letter [b]</td>
</tr>
<tr>
<td>ć</td>
<td>Ć</td>
</tr>
</tbody>
</table>

10 Not all of the symbols discussed in (12) are relevant to the following discussion; they are included for completeness. The relevant symbols are highlighted with arrows.
Example (13) illustrates the inventory of the final vowels of Pasiego.

(13) Pasiego word-final, unstressed vowels (Penny 1969: 49-55)

a. Pasiego final vowels (parallel to (2.c)):

/ø/    /u/

/A/

b. Phonetic realization of Pasiego final vowels (Penny 1969):

As shown in (13.a), Pasiego has four final unstressed vowels—parallel to the vowel system in (4.d)—which are realized in the manner shown in (13.b), where boxes indicate phonemes.

(14) and (15) illustrate the regular patterning of the tonic vowels (I abstract away from a process of centralization which does not bear on the current issue; cf. Hualde (1989), McCarthy (1984) and Wilson (1988) for discussion).

(14) Expected patterning of Pasiego tonic and final vowels (Penny 1969): 11

<table>
<thead>
<tr>
<th>Tonic vowels</th>
<th>Final vowels</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [i]</td>
<td>/ø/</td>
<td>/ø/</td>
</tr>
<tr>
<td>[e], [je]</td>
<td></td>
<td>/ø/</td>
</tr>
<tr>
<td>[o]</td>
<td>/u/</td>
<td>/u/</td>
</tr>
<tr>
<td>[a, wé]</td>
<td></td>
<td>/a/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no processes occur when the final vowels are phonologically non-high.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>t[ø]f[ə] 'tower'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gw[ɛ]n[a] 'good'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f.s.)'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gw[ɛ]n[o] 'good'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(neuter.s.)'</td>
</tr>
<tr>
<td>b. [i, j]</td>
<td>/u/</td>
<td>/u/</td>
</tr>
<tr>
<td>[u, w]</td>
<td></td>
<td>/u/</td>
</tr>
<tr>
<td>[а]</td>
<td></td>
<td>/а/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>raising of tonic /e/ and /o/; triggered by phonologically high /u/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gw[i]n[u] 'good'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(m.s.)'</td>
</tr>
</tbody>
</table>

(14) shows that when the final vowel is phonologically non-high, the full range of tonic vowels may appear. However, when the final vowel is phonologically high (/u/), then the mid vowels neutralize with the high vowels, and only the peripheral tonic vowels appear. (Recall that in a four-vowel asymmetric inventory of the type in (4.d), I suggested that the contrast in the back region forces the presence of [high] on /U/; this contrast is lacking in the front vowel region, and thus the front vowel /ø/ is unmarked for height.)

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11 I use square brackets for tonic and pretonic vowels because predictable stress is indicated. The underlying vowel system for tonic and pretonic vowels is that in (4.c).
(15) Expected patterning of Pasiego pretonic and tonic vowels (abstracting away from centralization):

<table>
<thead>
<tr>
<th>Pretonic vowels</th>
<th>Tonic vowels</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [i]</td>
<td>[u]</td>
<td>[ë]</td>
</tr>
<tr>
<td>[e]</td>
<td>[o]</td>
<td>no processes occur</td>
</tr>
<tr>
<td>[a]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. [i]</td>
<td>[u]</td>
<td>[í]</td>
</tr>
<tr>
<td>[a]</td>
<td>[je]</td>
<td>[úe]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example (15.a) illustrates that when the tonic vowels are non-high, then the full range of pretonic vowels may appear. Recall that in tonic position, Pasiego has five underlying vowels (and two diphthongs); in this type of five-vowel inventory (recall 4.b)), there are two phonologically high vowels, namely [i] (/'i/) and [ú] (/'u/) (as well as the phonologically high glide portions of the diphthongs [je] and [ue]). When the tonic vowels are high, as shown in (15.b), then they trigger metaphony, creating the pretonic mid vowels neutralizing with the high vowels. As a result, only the peripheral vowels ([i,a,u]) appear in pretonic position when the tonic vowels are phonologically [high].

2. Variable behaviour of Pasiego mid vowels

In general, vowels in Pasiego conform to the patterns summarized in (13) - (15). However, in a sizeable group of words, mid vowels have other surface variants that do not conform to the above patterns. The variable patterning of mid vowels is illustrated in examples (16) to (21). Square brackets draw attention to the relevant vowels in the first column, and the expected vowel, given the description in §A.1, is shown in the second column.

(16) Surface [e,o] where [i,u] is expected: 13

<table>
<thead>
<tr>
<th></th>
<th>expected vowel</th>
<th>submerged</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>sum[e]rxi(4)u</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>ø[ø][øad]u</td>
<td>[i]</td>
</tr>
<tr>
<td>c.</td>
<td>am[a]m[ø]u</td>
<td>[u]</td>
</tr>
<tr>
<td>d.</td>
<td>k[ø][øai]u</td>
<td>[u]</td>
</tr>
<tr>
<td>e.</td>
<td>k[ø][øed]u</td>
<td>[u]</td>
</tr>
<tr>
<td>f.</td>
<td>kúb[e]rtri</td>
<td>[i]</td>
</tr>
</tbody>
</table>

Example (16) illustrates the mid vowels /ø/ and /o/, which have failed to raise to high in a metaphonic environment.

---

12 In §II, I did not discuss the part of the process of metaphony illustrated in (15); this part of the process of metaphony is triggered by the tonic vowel, and in this way it differs from the metaphony triggered by the final vowel which is discussed in §II.

13 Predictable devoicing of word-final vowels that occur after voiceless obstruents has been removed from the examples that follow.
(17) Surface [ā] where [e] or raised /e/ -> [i] is expected:

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>Expected vowel</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[i]</td>
<td>puppy</td>
</tr>
<tr>
<td>a.</td>
<td>[i]</td>
<td>cf. p'ru (dog) vs.</td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>pf'ru (dogs)</td>
</tr>
<tr>
<td>b.</td>
<td>[i]</td>
<td>baby rabbit</td>
</tr>
<tr>
<td>c.</td>
<td>[i] or [i]¹⁴</td>
<td>fearful</td>
</tr>
</tbody>
</table>

Example (17) illustrates the underlying vowel /ə/, realized as a schwa. In all of these examples, the mid vowel in question should have raised to high in the metaphonic environment, as shown by the comparative forms in (17.b). However, the vowels do not raise to high, but are realized as schwas instead.

(18) The vowel in the prefix /des-/:

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>Expected</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[dəz]mēdr</td>
<td>[dis]</td>
<td>to split branches (for basketmaking)</td>
</tr>
<tr>
<td>b.</td>
<td>[des]pūsīṭōn</td>
<td>disposition</td>
</tr>
<tr>
<td>c.</td>
<td>[dis]kubrīr</td>
<td>discover</td>
</tr>
<tr>
<td>d.</td>
<td>[diz]nū(ə)u</td>
<td>[diz] naked</td>
</tr>
</tbody>
</table>

Example (18) illustrates the behaviour of the prefix that is underlyingly /dōs-/. This prefix is regularly realized as [dis-] or [diz-] before high vowels, as in (18.c,d). However, instead of the expected metaphonic variants, in (18.b) the variant [des-] appears, and in (18.a) the variant [dāz-] surfaces.

(19) The vowel in the prefix /re-/:  

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>Expected</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[re]spōndēr</td>
<td>[re]</td>
<td>respond</td>
</tr>
<tr>
<td>b.</td>
<td>[re]kosiyār</td>
<td>to gust</td>
</tr>
<tr>
<td>c.</td>
<td>[ri]swītu</td>
<td>[ni] turned over</td>
</tr>
<tr>
<td>d.</td>
<td>[re]strulītē</td>
<td>type of fight among animals</td>
</tr>
<tr>
<td>e.</td>
<td>[rā]swīnu</td>
<td>[ri] happy</td>
</tr>
</tbody>
</table>

Example (19) illustrates the behaviour of the prefix that is underlyingly /ro-/. This prefix is regularly realized as [re-] before non-high vowels (19.a) and as [ri-] before high vowels (19.c). However, it surfaces as [ri-] where a [re-] variant is expected in (19.b), and as [ri] where a [ri] variant is expected in (19.d), and as [rā-] where a [ri] variant is expected in (19.e).

A somewhat different type of behaviour is illustrated in (20) and (21). In these examples, the mid vowels can take on any height specification in initial position preceding /n/ or /s/, as argued by McCarthy (1984) and Spencer (1986).

---

¹⁴ With the diphthong /je/, the result of metaphony is often [jj], rather than [ji].
An underlying /ø/ preceding /n/ is variable:

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>Expected</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>cf. d.</td>
<td>intiñtẽr</td>
<td>/in/ → [in]</td>
</tr>
</tbody>
</table>

Vowels preceding s-stop clusters word-initially are variable:

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>Expected:</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [a]skwẽñẽ</td>
<td>/es/ → [es]</td>
<td>school</td>
</tr>
<tr>
<td>b. [e]skwẽñẽ</td>
<td>/es/ → [es]</td>
<td>school</td>
</tr>
<tr>
<td>c. [i]skwẽñẽ</td>
<td>/es/ → [es]</td>
<td>school</td>
</tr>
<tr>
<td>cf. d.</td>
<td>isplordẽr</td>
<td>/is/ → [is]</td>
</tr>
</tbody>
</table>

Thus in (20) and (21), the mid vowel /ø/ is realized as either [æ], [e], or [i] in initial position preceding /n/ or /s/.

As shown in (20.d) and (21.d), underlying /I/ also occurs in this position, instantiated as [i], but is invariant.

I divide examples (16) - (21) into two types of phenomena. Examples (17), (18) and (19) illustrate a limited amount of variation, where underlying empty /ø/ is realized as either [æ] or as schwa. (I abstract away from the [i] variants in (16), (19) and (20) because they are derivable from the application of [high] spreading, or metaphony.) Examples (20) and (21), on the other hand, are examples of free variation, which occurs only in initial position before /n/ and /s/. My purpose for including (20) and (21) is to show that underlying /ø/ is more variable than underlying /I/. Aside from making this point, I exclude (20) and (21) from the following discussion because they are clearly different from the examples in (16) to (19), where more limited variation holds in a more general context. Essentially, this means that the rest of this paper focusses on the problem of variation between [æ] and [i].

IV. Mechanisms for the realization and interpretation of empty vowels

In this section, I explain the variable behaviour of Pasiego mid vowels in terms of the vowel space model (described below) and context-sensitive interpretation. First I show that the vowel space model predicts greater variability for height in vowels that are unspecified for height. Then I employ this model to show that the variability in Pasiego is context-sensitive, i.e. that it occurs in metrical weak positions rather than in metrically strong positions. I then develop this observation into a model of phonetic enhancement in §V.

A. The vowel space model

In this section, I sketch an explanation of why variation between [æ] and [i] occurs in the first place. I adopt the vowel space model illustrated in (22) and (23).

In the vowel space model, what is important for the phonology are the number and types of contrasts present in a given vowel system, rather than the exact instantiation of, for example, the vowels of a given vowel system. Crosslinguistically, the more vowels or contrasts in a given system, the less room for variability; conversely, the fewer

---

15 I do not discuss the variation between [o] and [ø] in this paper, although the arguments and conclusions are parallel.

16 Cf Crothers (1978), den Dikken & van der Hulst (1989), Rice (1992), van der Hulst (1989) and also Lass (1984) and Dependency Phonology in general for discussion of this type of model.
vowels or contrasts in a given system, the greater the room for variability. Within a given vowel system, vowels with fewer features are more variable or take up more space than vowels with more features.

(22) Vowel variability, abstracting away from centralization, metaphor, and word-final variants:


b. Surface:

```
\[ \begin{array}{ccc}
  \text{I} & \text{u} \\
  \text{e} & \text{o} \\
  \text{a} & \\
\end{array} \]
```

The latter characteristic of the vowel space model is illustrated by the Pasiego example in (22), which graphically shows that the mid vowels, which are unspecified for height features (and in the case of /ø/; unspecified for any features) are more variable than the peripheral vowels of Pasiego.

The picture in (22) is not fine-tuned enough for the following reasons. As illustrated earlier in example (9), vowel distribution in Pasiego is quite sensitive to metrical structure. Not surprisingly, metrical structure also affects the realization of (variable) mid vowels in Pasiego, as shown in (23).

(23) Vowels in tonic and pretonic positions in Pasiego (abstracting away from word-final variants):

a. vowel space of tonic vowels b. vowel space of pretonic vowels:

```
\[ \begin{array}{ccc}
  \text{I} & \text{u} & \text{I} \\
  \text{e} & \text{o} & \text{e} \\
  \text{a} & \text{a} & \text{a} \\
\end{array} \]
```

Example (23) reflects the observation that vowels in tonic (main-word-stress) position never vary; only vowels inatomic (or non-main-word-stress) position do. I will fine-tune my observation concerning pretonic vowels in §B below, showing that in Pasiego, mid vowels in metrical head position are less variable than mid vowels in metrical dependent position.

B. Context-sensitive variability

In this section, I argue that the variable realization of mid vowels is contextually sensitive to metrical structure. In order to do so, I bring to bear all the data concerning mid vowels discussed in §III.A.2, and summarized in (24).
Weak variants:

i. [e, o] where [i, u] are expected by regular metathetic rules
ii. ['o] in word-medial position where [i] or [e] usually occur
iii. [o] in word-medial position where [o] or [u] usually occur

I refer to the vowels discussed in §III.A.2 as 'weak' variants, 'weak' in the sense of occurring in metrically weak positions. I will show that the weak variants only occur in specific pretonic positions, namely in metrically weak positions. This argument strengthens my position that variation in the mid vowels is context-sensitive. After making this argument, I will again focus solely on the variation between [e] and [a], which represents a subset of the variation summarized in (24).

C. Vowels in head and dependent positions in Pasiego

1. Spanish (Pasiego) stress algorithm

The position of the weak variants in (24) is predicted by the stress algorithm summarized in (25) which is largely derived from Halle, Harris and Vergnaud (1991).

(25) Spanish stress (after Halle, Harris and Vergnaud 1991 (henceforth HHV)):

a. a word-final vowel is extrametrical
b. the penult (rightmost visible vowel) receives main word stress.
c. in non-main stress position, trochees must branch (maximally/minimally binary trochee.
d. feet must be entirely contained within morphemes (an effect of cyclicity).

The essentials of the stress analysis are first that word-final vowels are extrametrical (25.a) (extrametricality is indicated by the use of angle brackets below). In Spanish, main word stress and secondary stress differ in their properties: Main word stress is essentially penultimate, as summarized in (25.b). The rule that derives this result always creates unary, strong, quantity-sensitive feet at the rightmost visible edge of the word. On the other hand, non-main word stress must build maximally/minimally binary trochees where possible, as summarized in (25.c).

Finally, as a consequence of cyclicity, feet must be entirely contained within morphemes. This essentially means that it may not always be possible to construct trochaic secondary feet preceeding main word stress (examples are provided below).

2. Examples of stress assignment

An example of the application of the stress algorithm is shown in (26).

(26) Main word stress (HHV 1991: 145):

```
line 2 *
line 1 (*)
line 0 (*) <*>
tax re a a task
```

17 I have also drawn on the following sources in this section: Nuñez Cedeño (1985), Harris (1987), Harris (1989), and Roca (1988, 1990).
18 Cf. Mester (1994) and also Drescher and van der Hulst (1993), who discuss systems in which main word stress behaves in a quantity-sensitive manner, while non-main-word stress behaves in a quantity-insensitive manner.
In (26), [tareá], the final syllable 'a' is designated as extrametrical (25.a); penultimate stress (25.b) results in a unary foot on the syllable 're.' However, the initial syllable 'ta' cannot be footed because in non-main-word-stress, trochees are obligatorily binary (25.c).  

The stress algorithm in (25), then, predicts that in three-syllable words with penultimate stress, the first syllable of the word should always be weak, regardless of the morphemic structure of the word in question. This is because after (25.b) applies, the initial vowel can never be footed, since unary trochees are not allowed in non-main-word-stress position (25.c). The initial vowel remains unfooted after the rules in (25) apply.

As shown in (27), the first syllable of three-syllable words (highlighted by square brackets) may indeed contain weak variants, i.e. unmetaphonized [e] (/o/) or [o] (/o/), or [ã] /o/.

(27) Three-syllable words with weak variants (DP = derivational prefix; DS = derivational suffix; IS = inflectional suffix):

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>DP</th>
<th>Derivational Root</th>
<th>DS</th>
<th>IS</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>tr[e]ntinu</td>
<td>tr[e]nt</td>
<td>in</td>
<td>u</td>
<td></td>
<td>30 month old colt</td>
</tr>
<tr>
<td>x[o]stiyu</td>
<td>x[o]st</td>
<td>iy</td>
<td>u</td>
<td></td>
<td>bib fastened with buttons or string (traditional clothing)</td>
</tr>
<tr>
<td>ū[ã]fáxu</td>
<td>ū[ã]fáx</td>
<td></td>
<td>u</td>
<td></td>
<td>underskirt, slip</td>
</tr>
<tr>
<td>ū[ã]gústu</td>
<td>ū[ã]gúst</td>
<td></td>
<td>u</td>
<td></td>
<td>robust (alternate form)</td>
</tr>
</tbody>
</table>

(28) Analysis of 3-syllable words (27):

2
1
0

Example (27) shows that initial position may contain the weak vowels (cf. (24)) predicted in (26). Example (28) illustrates that the three-syllable words shown in (27) always have an initial weak syllable, regardless of the structure of the word.

The hypothesis that weak variants only occur in metrical weak position is strengthened by the examples of 4-syllable words with weak variants, shown in (29)-(31). Four-syllable words fall into two types, those in which the second syllable contains a weak variant, as in (29), and those in which the first syllable contains a weak variant, as in (31).

---

19 Ultimately, the initial vowel may be incorporated into phrasal stress trochees, which are constructed between main word stresses. See Harris (1990) details.
(29) Four-syllable words with weak variants in the second syllable (DP = derivational prefix; DS = derivational suffix; IS = inflectional suffix):

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>DP</th>
<th>Derivational Root</th>
<th>DS</th>
<th>IS</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>aŋpe</td>
<td>liːtu</td>
<td>aŋpe</td>
<td>l</td>
<td>iːtu</td>
<td>u</td>
</tr>
<tr>
<td>ar[e]</td>
<td>nu</td>
<td>ar[e]</td>
<td>n</td>
<td>iː</td>
<td>u</td>
</tr>
<tr>
<td>imbe</td>
<td>ʃnθ</td>
<td>imbe</td>
<td>ʃn</td>
<td>iːθ</td>
<td>ʃ</td>
</tr>
<tr>
<td>kub[e]</td>
<td>ɾiːɾu</td>
<td>kub[e]</td>
<td>ɾiːɾ</td>
<td>iːɾ</td>
<td>u</td>
</tr>
<tr>
<td>prud[e]</td>
<td>nθʃs</td>
<td>prud[e]</td>
<td>nθʃ</td>
<td>iːs</td>
<td>u</td>
</tr>
<tr>
<td>puč[e]</td>
<td>ɾiːɾu</td>
<td>puč[e]</td>
<td>ɾiːɾ</td>
<td>iːɾ</td>
<td>u</td>
</tr>
<tr>
<td>lam[o]</td>
<td>ʃʃu</td>
<td>lam[o]</td>
<td>ʃʃ</td>
<td>jeq</td>
<td>u</td>
</tr>
</tbody>
</table>

As shown in (29), four-syllable words with weak variants in the second syllable have a unique morphological structure, in which the first morpheme is two syllables long.

(30) The first stem is 2-syllable (29):

| line 2 | *                     |
| line 1 | (*                      |
| line 0 | (* *)                  |
|        | aŋ xe                   |
|        | iʃ                   |

As illustrated in (30), because the first morpheme is 2 syllables long, there is 'room' to build a binary trochee preceding the main word stress. The metrical structure in (30) shows that the second syllable of such words will be weaker than either the first or third syllables. Again, the metrical structure in (30) predicts where the variants will occur in (29).

The second type of four-syllable words, with weak vowel variants in initial position, is exemplified in (31).

(31) Four syllable words with weak variants in the initial syllable (DP = derivational prefix; DS = derivational suffix; IS = inflectional suffix):

<table>
<thead>
<tr>
<th>Phonetic</th>
<th>DP</th>
<th>Derivational Root</th>
<th>DS</th>
<th>DS</th>
<th>IS</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ[e]</td>
<td>raduːɾe</td>
<td>θ[e]</td>
<td>ɾ</td>
<td>ad</td>
<td>ɾu</td>
<td>ɾ</td>
</tr>
<tr>
<td>b[e]</td>
<td>næʃʃ</td>
<td>b[e]</td>
<td>n</td>
<td>ad</td>
<td>iʃ</td>
<td>ɾ</td>
</tr>
<tr>
<td>k[o]</td>
<td>galə</td>
<td>k[o]</td>
<td>ɡa</td>
<td>a</td>
<td>iθ</td>
<td>u</td>
</tr>
<tr>
<td>k[o]</td>
<td>ʃdʊɾe</td>
<td>k[o]</td>
<td>ʃ</td>
<td>id</td>
<td>ɾu</td>
<td>ɾ</td>
</tr>
<tr>
<td>[ʃ]strinkas</td>
<td>[ʃ]ʃ</td>
<td>trink</td>
<td>ə</td>
<td>sə</td>
<td>ə</td>
<td>to stretch (oneself)</td>
</tr>
<tr>
<td>r[ʃ]buːɾuʃu</td>
<td>r[ʃ]</td>
<td>buːɾ</td>
<td>uʃ</td>
<td>u</td>
<td>ɾ</td>
<td>rebellious</td>
</tr>
</tbody>
</table>

As shown in (31), four-syllable words with weak mid vowel variants in initial position have a different morphophonemic structure from the four-syllable words in (29). Each morpheme in (31) is one syllable long.
(32) Analysis of types in (31) (v v ñ v):

\[
\begin{array}{cccc}
2 & * & \\
1 & * & (*)& \\
0 & * & * & (*) \\
\theta & [\theta r] & [ad] & [\bar{u}r] & [a] \\
\end{array}
\]

The metrical structure associated with words such as those in (31) is shown in (32). In this case neither of the first two syllables of the word in (32) can be metrified by the rules in (25): this is because non-main-word-stress trochees must be binary (25.c), and because feet must be contained within morpheme boundaries (25.d).

The analysis in (32) predicts then that the first two syllables of such words should be weak. While there is evidence for the weakness of the first syllable, as shown in (31), the evidence concerning the second syllable is inconclusive and requires further investigation (only the peripheral vowels /I, A, U/ occur in the second syllables of the examples collected).

In conclusion, however, the evidence in §IV shows that variable mid vowel allophones in Pasiego occur in metrically weak positions, rather than in metrically strong positions.

V. Interpreting empty vowels

Reiterating what has been discussed so far, the problem addressed in this paper is that mid vowels may exit the lexicon with no height features, in the case of /e/, resulting in an empty vowel representation. This empty representation needs to be phonetically interpreted. In the previous section, I argued that phonetic interpretation in Pasiego is context-sensitive (i.e. sensitive to metrical structure). In this section, I work out the rule of phonetic interpretation needed for the Pasiego data, assuming that phonetic interpretation in Pasiego is sensitive to metrical structure.

I propose that the rule in (33)—enhancement—could apply to mid vowels, under conditions to be described in §VI.

(33) Phonetic realization/interpretation:

\[
\begin{array}{cccc}
* & * & * & (enhancement) \\
[a] & [\theta] & [e] & \\
\end{array}
\]

or

\[
\begin{array}{cccc}
* & * & * & (lack of enhancement) \\
[a] & [\theta] & [e] & \\
\end{array}
\]

(This rule is described further around example (35).)

I propose that (33) is derivable from a model of phonetic enhancement such as that presented by Stevens and Keyser (1989). Stevens and Keyser (henceforth SK) distinguish between a group of features which are more basic (SK's primary' and 'secondary' features, which operate in the phonology) and a set of enhancement features. Functionally, enhancement features serve to increase either the perceptual salience of the more basic features, or the perceptual salience of a contrast.20

20 Johnson et. al (1993)'s findings concerning 'hyperarticulation' seem to support SK's interpretation of the functional role of enhancement. Johnson et al. (1993) provide evidence that phonetic targets are hyperarticulated, or that target vowels are much more acoustically salient than actual
I begin with an adaptation of Stevens and Keyser's model which has been developed within the MCS framework by Rice (1993), Rose (1993) and Walker (1993). This adaptation assumes monovalent features and Modified Contrastive Specification. I briefly review Rice's model of enhancement in (34) by way of introduction.

(34) MCS model of Enhancement (Rice 1993):

```
Underlying coronal/velar  surface coronal  surface velar
   Root       Root       Root
       |       |       |
     Place    Place    Place
        |       |
    Coronal
```

Rice (1993) argues that in some languages, a single underlying representation can be phonetically realized as either a coronal or a velar. The velar is similar, if not identical in pronunciation to a dorsal, but pattern differently from a dorsal. The underlying representation for the variable segment in question is a bare place node, as shown in (34). Under certain conditions, this segment may be enhanced by the addition of the feature [coronal], resulting in a surface coronal. If enhancement fails to take place, however, the representation in question is phonetically interpreted as a neutral segment, which Rice argues to be a velar.

I propose to extend Rice's model of phonetic enhancement to vowels in the following manner.

(35) Enhancement of vowels:

a. Underlying /ø/       surface [ɛ]       surface [ɔ] (unenhanced /ø/)

```
   Root       Root       Root
      |       |       |
    Place Aperture    Place Aperture    Place Aperture
        |       |
    Coronal
```

b.  

```
  high

  coronal  labial

  low
```

Recalling §1, I assume that front vowels generally lack [coronal] underlyingly. However, I propose that front vowels may or might be enhanced by the feature [coronal] in the phonetic component. If enhancement takes place, as shown in (35.a), a surface [ɛ] will result. If, however, enhancement does not take place, the resulting vowel will be 'performance' vowels (Johnson et al. 1993). This evidence may show that enhancement is a driving force in the phonetic implementation component.
interpreted as shown in (35.b)—that is, as a non-high, non-low, and non-labial vowel, or the neutral vocalic segment schwa.

As an aside, it is important to note that I abstract away from the peripheral vowels /I,A,U/ in this discussion. It appears—based on a survey of the five-vowel inventories listed in Maddieson (1984)—that the peripheral vowels have a greater tendency to be enhanced than do the non-peripheral (i.e. mid) vowels: of the five-vowel systems in Maddieson’s (1984) survey, 49 out of 67 (73%) had the enhanced or prototypical peripheral vowel realizations [i,a,u] (/I,A,U/). In comparison, 9 of the 67 (or 13%) of the five-vowel languages had variants such as [i̯], [u̯], or [u̯].21 This observation indicates that peripheral vowels tend to be enhanced. On the other hand, 17 of the 49 inventories that had enhanced peripheral vowels (i.e. 34%) had either one or two mid vowels which were NOT [e] (/ø/) nor [o] (/O/). For example, the system [i,a,a,o,u] occurs in Eastern Armenian, and [i,e,a,o,u] occurs in Swahili, Luvale, Kunimaipa, and Garo—the vowels [a] and [e] are typical instantiations of unenhanced /ø/ in other words, of the 49 inventories in the relevant sample, none had atypical peripheral vowels, while 49% had atypical mid vowels, and 10% had what appear to be unenhanced variants. These observations seem to indicate that the peripheral vowels /I,A,U/ are more likely to be enhanced (i.e. prototypical) than are the mid vowels.

VI. Summary, interpreting empty vowels

A. Optional enhancement

Returning to the Pasiegos data, recall that [e]—a strong variant—occurs in metrically strong position, while either schwa—a weak variant—or [e] may occur in metrically weak position. To explain this patterning, I propose that empty /ø/ is obligatorily enhanced in strong metrical position, but only optionally enhanced in metrically weak position, as shown in (36).

(36) Context-sensitive enhancement:

a. Metrically strong position (obligatory enhancement):

```
surface [e]  
  Root  
  | \  
 Place Aperture  
  |  
 Coronal
```

b. Metrically weak position (optional enhancement):

```
Enhancement applies:  Enhancement does not apply:

surface [e]  surface [a]  
  Root  
  | \  | \  
 Place Aperture  Place Aperture  
  |  
 Coronal
```

21 The remaining five-vowel languages were asymmetric.
As shown in (36.b), when enhancement fails to take place, schwa is the result in metrically weak position.

B. Implications: enhancement and reduction

In (37) to (40), I discuss the place of phonetic enhancement in a 'typology' of rules, referring specifically to two types of processes that can happen in languages, generally in metrically weak position.

Included in the list of processes which can occur or fail to occur in weak position is reduction, which is illustrated in (37) for Catalan.

(37) Reduction—Catalán (Mascaró 1978):

a. Tonic inventory:

\[
\begin{array}{c}
i \\
e \\
\varepsilon \\
a
\end{array}
\]

b. Atonic and final vowel inventory:

\[
\begin{array}{c}
u \\
o \\
\varepsilon \\
\varepsilon
\end{array}
\]

In Catalan, (and also in many Italian dialects), vowel reduction reduces the contrasts present in tonic position to three in atonic position. Reduction, however, is a process quite different from enhancement: reduction neutralizes contrasts, whereas enhancement makes contrasts more salient. Therefore atonic [a] can have two potential sources: in Catalan, reduction produces [ə], while in Pasiego, lack of enhancement produces [a]. The bottom line is whether contrasts are lost (in which case reduction is the process involved) or maintained (in which case enhancement is involved).

Reduction is only one type of option available to languages, as outlined below.

(38) Obligatory enhancement—Standard Spanish (García de Diego 1946):

a. Tonic inventory:

\[
\begin{array}{c}
i \\
e \\
a
\end{array}
\]

b. Atonic inventory:

\[
\begin{array}{c}
\varepsilon \\
o \\
\varepsilon
\end{array}
\]

As shown in (38), enhancement may also apply in strong and weak metrical positions, such that stressed vowels are realized in the same manner as unstressed vowels, as in Standard Spanish.

(39) Optional enhancement—Pasiego (Penny 1969):

a. Strong inventory:

\[
\begin{array}{c}
i \\
e \\
a
\end{array}
\]

b. Weak inventory:

\[
\begin{array}{c}
u \\
o \\
\varepsilon
\end{array}
\]

On the other hand, as shown in (39), enhancement may only optionally apply in weak positions, so that variable mid vowels in weak position are the result.
Enhancement may also categorically fail to apply in weak position, as shown in (40), which is an example from the final vowels of Calvello (an Italian dialect):

(40)   No enhancement in weak metrical position—Calvello (Gioscio 1985):

   a.  Underlying final inventory:
   b.  Final inventory under phrasal stress
       (no reduction, no enhancement):

       /i/     /o/     /u/     
       /i/     /a/     

   c.  Final inventory, no stress (reduction):  a

Calvello has four underlying final vowels, as argued by Gioscio (1985), and as shown in (40.a). Calvello final vowels reduce to /a/ (40.c) except under phrasal stress, where reduction fails to take place and the inventory in (40.b) surfaces instead. As shown in (40.b), enhancement fails to be an option in weak metrical position in Calvello: underlying /o/ remains an unenhanced [a], even under phrasal stress. This contrasts with underlying /ø/ in main-word-stress position, which is always enhanced to [e].

(41) No enhancement (Maddieson 1984):

   a.  /i a o u/   /i,ø,A,O,U/  (Eastern Armenian)

Finally, as shown in (41), [coronal] enhancement may categorically fail to apply to /ø/, even in strong position. However, such cases appear to be rare; the example in (41) is the only one of 67 five-vowel languages in Maddieson's sample.

C.  Summary and predictions

To summarize, I have proposed the model in (42), in which the vowel /ø/ leaves the phonological component without features. The empty vowel /ø/ may still acquire some features, however, by means of enhancement.

(42) Modified Contrastive Specification and Phonetic Enhancement:

<table>
<thead>
<tr>
<th>Phonology</th>
<th>/ø/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonetic enhancement</td>
<td>yes no</td>
</tr>
<tr>
<td>by [coronal]</td>
<td>[e] [æ]</td>
</tr>
<tr>
<td>by [high]</td>
<td>[i]</td>
</tr>
<tr>
<td>by [coronal] and [high]</td>
<td>[i]</td>
</tr>
</tbody>
</table>

In the phonetic component, if enhancement applies, the phoneme /ø/ is interpreted as a [coronal] front mid vowel ([e]). If enhancement does not apply, /ø/ is interpreted as the neutral, default vowel schwa. (I discuss the enhanced realizations [i] and [i] shown in (42) shortly). In the phonology, however, the phoneme /ø/ always behaves like an empty

---

22 Calvello unstressed vowels are reduced to [æ]
23 I assume here that the inventories reported in Maddieson (1984) are in the default case those that appear under main word stress.
vowel, and, crucially, the feature [coronal] is not active. This is because [coronal] is a phonetic enhancement feature, not an underlying feature (modulo the assumptions discussed in §1B).

In this paper, I briefly indicated some areas for further research, which I reiterate and elaborate on below by way of conclusion.

Included in (42) is the evidence (discussed in §1 and in §VI.B under the rubric of three vowel systems) that the empty vowel representation /ø/ might be variably realized as either [i] or [i] (a centralized variant of [i]) in some inventories. In the spirit of the approach outlined in this paper, the [i] and [i] realizations of /ø/ could be explained as follows: when the empty vowel /ø/ is enhanced by the feature [high], it is realized as [i], and when /ø/ is enhanced by both [high] and [coronal] it is realized as [i].

As illustrated in (43), the patterning of Pasiego final vowels, discussed in §III.A.1, also provides some evidence for how the peripheral vowels /I/, /A/, and /U/ might be treated in the phonetic enhancement model outlined here:

(43) Other enhancements:

<table>
<thead>
<tr>
<th>Phonology</th>
<th>/I/</th>
<th>/A/</th>
<th>/U/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[high]</td>
<td>[low]</td>
<td>[high, labial]</td>
</tr>
<tr>
<td>Phonetics enhancement</td>
<td>yes</td>
<td>no</td>
<td>yes no</td>
</tr>
<tr>
<td>(coronal)</td>
<td>(radial)</td>
<td>(dorsal)</td>
<td></td>
</tr>
<tr>
<td>[i]</td>
<td>[i]</td>
<td>[a]</td>
<td>[u]</td>
</tr>
</tbody>
</table>

In Pasiego, the unenhanced variants of /A/ and /U/, which occur most typically in word-final position, are respectively raised [a] and centralized [u]24 (transcribed as [u:] in Penny (1969)). If Pasiego is any indication, unenhanced peripheral vowels might be realized as more centralized variants. Treating the vowel /I/ in a similar manner (recall that Pasiego has no final /I/), I propose that the unenhanced instantiation of /I/ is a centralized [i]. If enhanced by the feature [coronal], /I/ would be realized as [i]. Further research is needed in order to determine what are the enhancement features for /A/ and /U/; however, promising candidates, drawn from Clements (1991), include [dorsal] (for back vowels) and [radial] (i.e. pharyngeal constriction) for low vowels (as shown in (43)).

In summary, my proposal makes limited, testable predictions about the degree of variability allowed in particular inventories: The model outlined here predicts that variability in phonetic instantiation is a function of the degree of specification of the underlying representation. For example, /I/, which is specified as [high], has two possible phonetic instantiations (43); in contrast, /ø/, which has no features, has three possible phonetic instantiations (42). This is a direct consequence of the fact that /I/ can only be enhanced by the addition of a place feature ([coronal]), whereas /ø/ can be enhanced by either the addition of a place feature ([coronal]), or the addition of a height feature ([high]), or the addition of both ([coronal] and [high]). Furthermore, because vowels in inventories with a greater number of contrasts are forced to be more specified than vowels in inventories with a fewer number of contrasts (cf. §IV.A), it then follows that there are fewer possible phonetic instantiations—i.e. less opportunity for enhancement rules to apply—in large inventories than in small inventories.

In summary, then, I have outlined a model of phonetic interpretation which assumes underspecification, and which predicts both the shape and the degree of variability in phonetic realization possible in given inventories.

24 The transcription used here is from Lass (1984).
VII. References


