Markedness and the typology of epenthetic vowels

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Using cross-linguistic evidence from the relationship of epenthetic vowel choice to the vowel system of a given language, this paper proposes a set of context-free markedness constraints on vowel features. Universally ranked constraints yield the result that front vowels are more marked than back and that round vowels are marked; languages may vary in how they rank the markedness of low and nonlow vowels. If low vowels are unmarked the epenthetic vowel is [a]. If nonlow vowels are unmarked, the epenthetic vowel is the least marked possible given the vowel system of the language. [ɨ] is epenthetic if present; [ə] is epenthetic if it is present and [ɨ] is not; these vowels are unmarked on the backness and rounding dimensions. If neither 'central' vowel is part of the system, the epenthetic vowel will generally be [i]: constraint conflict forces the choice of a more marked front vowel in order to avoid violations of markedness on the mid and round dimensions.

1. Introduction - Consonant epenthesis variability

It has often been claimed that representational simplicity accounts for why particular segments tend to appear in epenthesis (eg, Paradis and Prunet 1991, Rice 2001). Concentrating on Place features, then, an epenthetic glottal stop would be a segment with no Place.

However, this approach has a number of problems. Languages may differ in their choice of epenthetic consonant. Work on Coronal underspecification has argued that Coronals have no Place features, based partly on the claim that Coronals may be epenthetic. If a language has both coronals and glottals, then we must have some way to distinguish them, but the coronal underspecification literature has never worked out the details of how this is done. We would also expect natural class effects of coronals and glottals, which have not been well supported in the literature. Finally, different representations would be required for glottals in different languages[1]. In some languages, like Arabic, glottal stop and [h] pattern in a natural class with the guttural consonants, so they in those languages they must have Place features.

As I have shown in previous work, (Lombardi to appear) we do see both coronal and glottal epenthesis, both across and within languages. But rather than evidence for different representations in different languages and contexts, such variation is a classic case of Optimality-Theoretic constraint

conflict. OT recognizes that there are different dimensions of markedness and, via constraint ranking, explains why not all of them may be perfectly satisfied at the same time.   I assume that the Major Place feature of glottal stop is Pharyngeal, following McCarthy (1994). We then can add *Phar to the bottom of Smolensky (1993)'s Place markedness scale:

(1)   *Lab, *Dor >> *Cor >> *Phar

If no other considerations intervene, glottal stop will be the optimal epenthetic consonant, since it has the lowest ranked violation on this scale.
As we see in (2), the high ranked constraints make epenthesis the optimal response to hiatus, so the competition is between candidates like a and b with different inserted consonants. The Place markedness scale makes the choice in favor of glottal stop, which has the lowest ranked violation.

(2)

/gao/	(Max, Onset)	*Cor	*Phar
☞ a. gaʔo			*
b. gato		*!	
c. ga	*!		
d. ga.o	*!		

However, sometimes other constraints make it impossible to choose glottal stop in epenthesis; then, given the principle of minimal violation, you still get a relatively unmarked Place, coronal.   In the following examples, a preference for sonorant codas conflicts with *Place constraints. In the Bristol dialect of English schwa-final words take an epenthetic /l/ in the coda as we see in (3) (Hughes and Trudgill 1979).

(3)

/ivə/	SonCoda	*Cor	*Phar
☞ivəl		*	
ivəʔ	*!		*

I assume glottal stop is an obstruent, a true stop (as do a majority of those who

have proposed basic feature definition: see Lombardi to appear for references). Thus glottal stop violates the high ranked constraint preferring the coda to be sonorant. A sonorant must be chosen, and [l] still has a fairly low ranked Place, Coronal. Due to constraint conflict, then, Coronla is the best we can do on the Place markedness scale in this case.

In Tunica (Haas 1940) we see both coronal and glottal epenthesis in a single language. The contexts make phonological sense, so it is straightforward to acheive the difference via constraint ranking. Phrase-final words must end in a consonant, so /n/ is epenthesized word-finally:

(4)   regular form phrase-final form   (Tone omitted)
              hatika   hatikan   "again"
              sahku   sahkun   "one"

Certain kinds of words with final stress must add a prothetic final syllable in order to be able to take epenthetic final /n/. This added syllable has glottal stop onset and a copy vowel, and /n/ in the coda:

(5)   Regular form   Phrase-final form   Gloss
              ri   ri?in   house
              ke   ke?en   wasp
              ru   ru?un   hickory

(6) (*Place marks for the underlying /r/ are omitted.)

/ri/	*SonCoda	*Cor	*Phar
ri?i?	*!		**
☞ri?in		*	*
rinin		**!	

Thus we see within a single language, even a single form, different results for markedness in onset and coda. Because the onset is not subject to a requirement of high sonority, the least marked Place, Phar, is optimal. But in the coda, which must be sonorant, the best we can do is Coronal.

This analysis does not require two different consonants in the same language to be Placeless, with the resulting worry about distinguishing them. It also allows us to have consistent representations for all segments. We don't

have to say glottal stop has Place in Arabic and no Place in Tunica, nor that coronals are Placeless in some situations but have Place in others, such as where they participate in natural class effects including the more marked coronals (see McCarthy and Taub 1992).

OT-internal arguments for lack of specification are certainly possible (for example, I have argued for privative voice within OT, Lombardi 2001). But representational assumptions must be reexamined in a new theory, since they are based upon theory-internal arguments. The analysis with ranked markedness constraints shows that we do not need underspecification to account for markedness effects in epenthesis. Since we need ranked markedness constraints for other reasons anyway, there is no advantage to assuming an underspecification analysis for these cases.

2. Vowel epenthesis: the question

Given that an OT analysis can account for different epenthetic consonants via constraint conflict without underspecification, the obvious next question to ask is about vowels. Vowel epenthesis shows much more variability than consonant epenthesis. Can we similarly account for it with ranked markedness constraints?

Similarly to consonant epenthesis, vowel epenthesis has been accounted for via underspecification, for example schwa is often claimed to be featureless. But many different vowels can be epenthetic. To account for differences in epenthetic vowels via underspecification, different representations for the same vowels in different languages have been assumed. These different representations seem even more stipulative than in the consonant case, since so many different epenthetic vowels are attested.

I will argue that we can account for the differences in vowel epenthesis via ranked markedness constraints with fully specified representations, as for consonants. I will show that differences in possible epenthetic vowels are not arbitrary; they depend on the vowel system of the language and show that only a minimal amount of free reranking of markedness is possible..

The data on which I base my generalizations is summarized in the Appendix.. Note that naturally we are ignoring cases where the quality of the epenthetic vowel is determined by context, such as vowel harmony, since these obviously involve the action of additional constraints which outrank context-free markedness.

Many observations have been made about epenthetic vowel possibilities but no real systematic generalizations have been proposed[2]. Based on my survey of the data I find the following markedness relationships among vowels. Previous authors have sometimes noted one or the other piece of these generalizations, but the overall connections have never been made.

(7)a.   Languages may vary in whether low or nonlow vowels are less marked. If low vowels are less marked the epenthetic vowel will be
/a/.   *low, *nonlow: rerankable
b. If nonlow vowels are less marked, other constraints choose among them:
Back vowels are less marked than front vowels: *Front >> *Back
Mid vowels are marked: *Mid
Round vowels are marked: *[+round] >> *[-round]

The free ranking of height constraints makes sense, since we have no evidence from vowel systems of any implicational relationship. Vowel systems always have a height distinction although they (arguably) may be able to lack most other distinctions. The other vowel distinctions have a universal markedness ranking as we see for Place features for consonants.

This set of constraints makes strong predictions about the possible epenthetic vowel given the sound system of a particular language.   Setting aside the low vowel, the least marked vowels are /ɨ/ and /ə/: they are back and unrounded. /ɨ/ is the less marked of the two, since it is not Mid. Where these vowels appear in systems they are likely to be the epenthetic vowel. Where they are not, languages will choose the least marked vowel possible. Assuming the ranking where [low] is more marked, which allows us to see the rest of the possible variability, the results are as in (8):

(8)   If /ɨ/ is present it will be epenthetic: Nonlow, nonmid, back, nonround
If /ɨ/ is not present but schwa is, schwa will be epenthetic: Nonlow, back, nonround
If neither schwa nor /ɨ/ is present, the usual epenthetic vowel is /i/, which is nonmid   and nonround, even though it's more marked in Frontness.

There are a few cases that seem to stand outside these generalizations. I will return to these in Section 4.

In the next section I will show how the constraint rankings result in the different vowels in different systems. I will begin with the smaller systems, which lack the central vowels and so have more marked vowels in epenthesis.

3.Rankings
3.1 Five vowel systems
In such systems, the epenthetic vowel is either /i/ or /a/. If *nonlow>>*low, /a/ is epenthetic. /a/ is unmarked both in height, and on Front/Back scale, which is not rerankable.

(9)

/pig/	*Front	*Back	*nonlow	*low
pigi	*!		*!	
☞piga		*		*

Relative ranking of the height and place hierarchies doesn't matter, because they don't conflict: both agree that /a/ is least marked. Thus ! is marked on both of the violations.

The other possible Back vowel is more marked than /a/ in this language because of the ranking of the height constraints, but also because of the universal ranking *[+round] >> *[-round]. So a variety of relative rankings of these hierarchies can result in /a/ epenthesis   Reranking the constraint pairs in (10) makes no difference to the results.

 (10)

/pig/	*Front	*Back	*+round	*-round	*nonlow	*low
☞piga		*		*		*
pigu		*	*!		*!	

Since the height constraints are rerankable, another possibility is *low >*nonlow. This is the more interesting case for our purposes: Since languages have more nonlow vowels, this is where we will be able to see the action of additional markedness constraints to choose among them.

Even with that ranking of the height constraints, if they are ranked below *Front>>*Back, /a/ can still be optimal, depending on where *round is

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ranked, as we see in (11).

(11)

/pig/	*Front	*Back	*round	*low	*nonlow
pigi	*!				*
pigu		*	*!		*
☞piga		*		*	

But if the height constraints are ranked above *Front>>*Back, the result is /i/ epenthesis. /i/ is preferable to /a/ because it is more important to be [-low] than to be unmarked on the front/back scale, as we see in 12.

(12)

/pig/	*low	*nonlow	*Front	*Back
☞pigi		*!	*	
piga	*			*

The only other possible nonlow vowel in a three vowel system, /u/, is ruled out by *[+round], as we see in 13.

(13)

/pig/	*low	*nonlow	*+round	*-round	*Front	*Back
☞pigi		*		*	*	
pigu		*	*!			*

Here we see real effects of constraint conflict.   It is not possible to be lowest ranked on both scales due to the conflict, so the more marked vowel on back/front dimension is optimal.

(As you can see from this tableau, it would be possible for [u] to be epenthetic if round and low hierarchies were reversed in this tableau. I will return to this in section 4.)

In a five vowel system the result is the same. Either /a/ or /i/ are possible depending on ranking of height constraints. If it is *nonlow >> *low, /a/ will be optimal since it best satsifies both hierarchies:

(14)

/pig/	*Front	*Back	*nonlow	*low
pigi	*!		*!	
pige	*!		*!	
pigu		*	*!	
pigo		*	*!	
☞piga		*		*

In the latter case, the markedness of mid vowels doesn't actually come into play - that they are nonlow is sufficient to rule then out that they are nonlow.

With the opposite ranking of the low constraints, /i/ is still optimal. The markedness constraint on mid vowels becomes crucial, no matter where it is ranked.

(15)

pig	*low	*nonlow	*Front	*Back	*Mid
☞pigi		*	*		
piga	*!			*	
pige		*	*		*!

More discussion of issues regarding the ranking *Mid constraint will be found in section 4.

3.2: More complex systems: "Central" vowels
So far we have seen that a variety of rankings give the same results in 3 and 5 vowel systems. If *nonlow>>*low, /a/ is epenthetic (9,10), as well as if *low >*nonlow, but front/back and *round are high (11,14). But if *low >*nonlow is more important than front/back markedness the epenthetic vowel

is /i/ (12,13,15).

But we have limited ourselves to only very simple vowel systems. Although these cases are familiar, we now need to look at the important cases that have the vowels I claimed are unmarked. These vowels are often described as central but assuming a minimum number of vowel features they are analyzed as [+back -round]. These vowels, /ə/ and /ɨ/ are epenthetic in preference to other nonlow vowels in languages that have them in their system. This is because they are unmarked on the markedness scales we have already discussed: back, non low, nonround.

With only /ə/ in the system and the ranking *low>>*nonlow the optimal epenthetic vowel will be /ə/.   Relative ranking of front/back and height hierarchies doesn't matter: they don't conflict on their evaluation of schwa.

(16)

/pig/	*low	*nonlow	*front	*back
pigi		*	*!	
piga	*!			*
☞pigə		*		*

This result is the same in a 5 vowel system. /e/ will have a fatal *Front violation that schwa does not have, and /o/ has a more marked value of round.

Of course a language with /ə/ in the system can have /a/ epenthesis instead, since height markedness is rerankable, as in (17).

(17)

/pig/	*nonlow	*low	*Front	*Back
pigi	*!		*	
☞piga				*
pigə	*!			*

Continuining to consider languages with more complicated vowel systems, a fairly common epenthetic vowel is [ɨ]. In fact, in most languages that have

this vowel and have evidence of epenthesis it is the epenthetic vowel. Of course [a] is also possible with the same ranking as (17). But if nonlow is less marked, the epenthetic vowel is /ɨ/ . It is preferable to schwa, which is mid, and to the other nonlow back high vowel, /u/, which is round, as we see in (18):

(18)

pig	*low	*nonlow	*Front	*Back	*Mid
pigi		*	*!		
☞pigɨ		*		*	
pigə		*		*	*!

As can be seen from this tableau this is the most unambigious result in the paper. Under any ranking of the rerankable constraints here, the result is the same.

4. Some remaining data and ranking issues

  Recall tableau (16), repeated here with *Mid added:

(19)

/pig/	*low	*nonlow	*front	*back	*Mid
pigi		*	*!		
piga	*!			*	
☞pigə		*		*	*

For schwa, a mid vowel, to be epenthetic, we must have *Mid below both of these two hierarchies (which do not have a required relative ranking.) If it were at the top, for example, we would get /i/ epenthetic, as the sad face shows us in (20):

(20)

/pig/	*Mid	*low	*nonlow	*front	*back
☹pigi			*	*	

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piga		*!			*
pigə	*!		*		*

 But the data shows that /i/ epenthesis only occurs in languages that do not have schwa. The problem results from assuming that that *Mid is freely rerankable with respect to other markedness constraints.   The epenthesis facts show that there is not in fact this much freedom.   So as we normally do in such a situation,we can account for the facts with universal rankings, which correctly express the generalizations in question as in (21):

> (21)   round constraints >> *mid,   front/back constraints >> *mid

Other proposed universal hierarchies that I know of are all rankings of different values of the same feature. However, these are not all plus/minus oppositions, since the different Place features are generally assumed to be universally ranked as well. There seems to be no principled reason to exclude rankings like (21) if they are supported by the phonological evidence.[3]

        Another case where we might consider such a ranking comes from (13) repeated here. In order to get the effect that in a language where the epenthetic vowel is high and the only choices in the system are /i/ and /u/, we need to rank the constraints on rounding above those on backness:

(22)

/pig/	*low	*nonlow	*+round	*-round	*Front	*Back
☞pigi		*		*	*	
pigu		*	*!			*

  As you can see from this tableau, it would be possible for /u/ to be epenthetic if round and low hierarchies were reversed in this tableau.

        For both of these cases, the real issue is that while we expect epenthesis to result in unmarked segments, the vowels /u/ and /e/ are marked under any view of the facts about vowels.   For example Maddieson (1983: 142) notes that unexpected gaps in systems suggest that /u/ is the most marked vowel, /e/ second most marked.

The question that needs to be answered, then, is not why these vowels are unmarked in certain languages; it is why we find cases of epenthesis of marked vowels. When we look at the question in this way, the answer we expect to find is different. In fact it appears that where there are well attested cases of epenthesis of marked vowels in well described languages, these cases have special qualities: contextual factors are relevant, for example, or there are special morphological restrictions. Therefore, additional constraints must be contributing to the situation, obscuring the expected results of the context-free markedness constraints.

For both the [u] and [e] cases additional research is required, but so far my research indicates that the issues appear to be different for the two vowels. It is unclear whether true phonological [u] epenthesis is really possible (see the Appendix for discussion). If it is not, the round/low ranking in (22) is universal. In contrast, [e] epenthesis is well attested, but it appears that it is usually explainable by contextual effects. Kitto and DeLacy (1999) note that in 8 lgs with epenthetic /e/, it was almost always in closed syllables and note that languages often have alternations /ə/->[e] in closed syllables. For example in Hebrew there is epenthesis of /ə/ in open syllables and /e/ in closed, because there is no /ə/ in open syllables. Examples like this, then, show additional contextual effects that don't disconfirm the context-free generalizations I have described. Additional cases of [e] epenthesis that seem likely to submit to such an explanation are Spanish, Basque (Hualde 1991) (in both, the epenthetic vowel is always in a closed syllable) and Gengbe (Abaglo and Archangeli 1989). Additional examples are discussed in the Appendix.

5. Faithfulness: Some issues in vowel systems.
So far, we have assumed that the vowel systems are given: the generalizations are of the form, if such a vowel is possible it will be epenthetic. But the issue of how the possible vowels are determined has been sidestepped: that is, there is no Faithfulness in any of the tableaus.

My main concern in this paper is to determine the what the context free markedness constraints are. In order to see the effects of these constraints without interference the evidence comes from epenthesis, since faithfulness constraints do not apply to epenthetic vowels, which have no counterpart in the input. The correct formulation of vowel faithfulness constraints is outside the scope of this paper.

However, there is an issue that is directly relevant to my claims: I have

claimed that certain vowels, schwa and [ɨ], are low marked, but these vowels do not occur in all languages.   If they are unmarked, why don't all languages allow them?

The data from consonant epenthesis show a similar effect. Glottal stop is the most optimal epenthetic consonant, so it seems to be the least marked. But, not all languages have glottal stop in their systems.

Implicational relations and markedness are traditionally assumed to be directly connected: A is less marked than B because the presence of B in a system implies A.   Nevertheless, most markedness claims of this kind have some exceptions and can only be stated as tendencies. In OT we can see why this is the case: because constraints conflict. No single implicational relationship will always hold true because different kinds of markedness fight it out: because languages can differ in ranking, other constraints can force the violation of a markedness hierarchy. In the case of glottal stop, it is low marked on the *Place scale. But in other respects glottal stop is a problematic consonant. It is not very perceptible. As we see in English, it only occurs in onset, since it's even less perceptible in coda. So glottal stop is unmarked in production terms but marked in perceptual terms. Different languages resolve this conflict differently. So although glottal stop is unmarked on one dimension, it is also marked on another , and the latter may result in it being absent from a system.

A similar situation seems to arise with the back unrounded vowels. They are unmarked in articulatory terms, which is formalized by the constraints we have already discussed.   But they are marked in other ways. Recall that certain kinds of context-senstive markedness are crucial in vowel systems. If nonround is less marked than round, then why do so many systems have the round [u] and not the unround [ɨ]?   This is presumably related to the enhancement effect of rounding: Rounding enhances backness, so unround back vowels are harder to perceive. (Also DeLacy 2002 suggests that [ɨə] are worst in sonority, which violates the requirement vowels should be sonorous.)

Thus, there must be additional constraints on feature combinations that can conflict with the context free markedness constraints that I concentrate on in this paper. Although /ɨ/ is unmarked on the context-free markedness dimensions, it must also be subject to constraints that penalizes its particular *combination* of features. When we evaluate combinations, /u/ is preferable

because of the enhancement effect of rounding, which /ɨ/ lacks.

This is in contrast for example to front vowels where rounding is marked due to the context-free markedness constraints (presumably, by the way, rounding is marked because it's more articulatorily complex) and it is not good for anything else. Therefore, rounding markedness is not in conflict with anything that prefers rounding, so unrounded front vowels are always preferable.

6. Conclusion
I hope to have shown that although languages differ in their choice of epenthetic vowel, that choice is nevertheless constrained by markedness constraints and the nature of the vowel system. There is some free reranking: whether [+low] or [-low] is less marked is a language-particular matter. But all other variability can be accounted for by conflict among universally ranked constraints: the epenthetic vowel is the least marked vowel possible given the contents of the language's vowel system.
This accounts for the majority of cases. There are still a few where vowels which are marked in anyone's calculation are nevertheless found in epenthesis, where we expect the unmarked. In a number of cases these seem to be due to contextual effects which outrank the effects of the constraint proposed here. Future research should focus on determining what contextual effects explain the remainder of the cases. More research is also needed into the faithfulness constraints that yield the different vowel systems: Some systems lack vowels that I (and other researchers) have claimed are unmarked. It is intuitively clear that these are the result of constraint conflicts but the details of the vowel faithfulness constraints remain to be determined.

Appendix
In many cases, analyses differ on the description of the vowel system. In all of these cases the result fits my generalizations whichever analysis we accept. I have listed such cases under the version that seems more plausible.

i. Schwa epenthesis - no ɨ in system
Dutch (Booij 1995, Warner et al 2001), Sekani (Hargus 1988), Tigre (Raz 1983), Hindi loans (except [ɪ] word-intial [s] clusters; Koshal 1978), Awngi (Cushitic; Hetzron 1997; vowel written ə is described as high), Morrocan Arabic (Heath 1987), Lenakel (/ə/ has [ɨ] allophone as well; Kager 1999), Berber (Kossman and Stroomer 1987, although contrast Dell and Elmedlaoui 1985 who analyze syllabic consonants instead for their dialect), Malayalam

(dialects have either /ə/ or /ɨ/, not both; Sadanandan 1999), German (Wiese 1996), English; from deLacy 2002: Chukchi, Itelman, Karo Batak, Ladahki, Malay, Mongolian, Wolof.

ii. [i] epenthesis, no [ə] or [ɨ] in system
Yawelmani (Archangeli 1984; changes to [u] by harmony), Plains Cree (Wolfart 1973), Nisgha (Tarpent 1989; [u] or low vowels by context, otherwise [i]), Ponapean (Rehg and Sohl 1981; [u] or copy vowels in certain context),Kɔnni (Gur, Northern Ghana, Cahill 1999; [i,ɪ] by ATR harmony; in dorsal contexts [u,ʊ]), Cantonese loans (Cheng 1990, Yip 1993), Navaho (McDonough 1990); Yoruba loans (Pulleyblank 1988, [u] in some contexts), Tongan, Maori (Kitto and de Lacy to appear),most Arabic dialects (Farwaneh 1995, Haddad 1984 except Saudi, Sudanese /a/ Moroccan /ə/); from deLacy 2002: Alabama, Manam, Ojibwa, Pali, Pilpil.

iii. [ɨ] epenthesis, [ə] also in system
Inor (Ethiopian Semitic, Prunet 1996), Korean loans (Tak 1996), Tigrinya, Amharic (Buckley 1997, Leslau 1997: traditional transcription is /ə/, but is high vowel), Chaha (Banksira 2000), many languages of Papua New Guinea (Foley 1986, Bruce 1984), Kodava (Kodagu) (Ebert 1996).

iv. [ɨ] epenth, no [ə] in system
Yakima Sahaptin (Hargus 2001), Yimas (New Guinea, Foley 1991),Tabukan Sangir (Maryott 1965), Ge'ez (Gragg 1997), various Dravidian (Bright 1975, Christdas 1988, Shankara Bhat 1967), Japanese loans (with some contextual variation), Karao ([a] in contexts where [ɨ] is disallowed)(Brainerd 1994).

v. [a] epenthesis
Axininca (Payne 1981), Lardil (Wilkinson 1988), Marathi (Pandharipande 1997), Balochi (Iranian, Elfenbein 1997a), Brahui (Elfenbein 1997b), Sundanese (Stevens 1977), Wapishana (Arawakan, Tracy 1972), Iraqw (Rose 1996), Choctaw (Nicklas 1975), Klamath (Barker 1964),
Dakota (Shaw 1980); from deLacy 2002: Coos, Mabalay Atayal, Mesola Italian.

vi. Apparent counterexamples
Khmer has [ɨə] in the vowel system and has been claimed to have [ə] epenthesis in minor syllables. The implicit assumption of most descriptions is that this is some kind of epenthesis - that vowelless clusters are underlying and that different kinds of clusters then get different pronunciations, ranging

from no epenthesis to aspiration to schwa. I have heard these examples and they sound like different kinds of phonetic transition. When a sonorant is initial in the cluster, the transition is voiced and sounds like schwa. Primary sources such as Henderson (1952) report more variation than later analyses; also cf Huffman (1972): "There appears to be a phonetic continuum from monosyllables on the one hand and disyllables on the other

The facts of Temiar are similar . But Gafos (1996:81), notes that actually there are more vowel qualities in the minor syllables and all are determined by context.

Karo Batak (Woolams 1996) has both ə and ɯ in system. ə epenthesis is optional word-initially before a nasal-voiceless stop cluster. ɯ does not occur word-initially (in addition to other restrictions on its appearance) which accounts for the need for a different epenthetic vowel in that position.

DeLacy (2002) analyzes Shipibo (Lauriault 1948, Elias 2000) as having an epenthetic vowel that surfaces as [a] or [i] depending on foot position, although there is [ɨ] in the system. However, it is unclear why deLacy analyzes the vowel as epenthetic. Elias p.c. informs me that there are no situations where this morpheme occurs without a vowel, so the evidence indicates that it is underlying.

Dschang (Bird 1999) loanwords take epenthetic [i] although [ɨ] is in the system. The loans are taken from languages that do not have [ɨ], which may be relevant. It seems plausible that an analysis in terms of different phonology for vocabulary strata would be appropriate in this case, since there are other differences in loanwords: they allow a trill consonant, a new type of onset cluster, and a CVVC syllable type that are not allowed elsewhere in the language. (Thanks to Ingo Plage for this suggestion about the treatment of differences in loan epenthesis.) Bird notes that other authors have analyzed [ɨ] as the realization of an underlying diphthong [iu] but aside from Bird's own arguments against this, it would be an unlikely choice for epenthesis.

vii. Epenthesis of marked vowels
As noted in the text, [e] epenthesis is not partcularly uncommon, but in the cases that are well understood it appears that contextual factors are involved. Additional cases that I know of are the following.

Kitto and deLacy note French and Sekani as cases where the epenthetic

vowel is [e] and is in a closed syllable; Sekani (Hargus 1988) also appears to have morphological conditioning.

Mohawk   (Michelson 1989) has [i e a] epenthetic in different environments. It's possible that none of these are totally general, as all her rules mention very specific contexts. In particular, three rules for epenthetic [e] rules refer to stem boundary; both previous vowel and following C; and previous [e], following C, and word final final.

The Athabaskan language Slave has a (Rice 1989) prothetic initial syllable /he/ used to meet a minimal word effect.

Galician (Colina 1997) has the same [e] epenthesis before word intial clusters as in Spanish (discussed in the text). Colina also argues for a process of word-final [e] epenthesis, where it would be in an open syllable, but it is not clear that this is really a productive process. In a dialect of Galician which has optional and therefore clearly productive word-final epenthesis (Martinez-Gil 1997) the vowel actually surfaces as [i].

Sawai (Whisler 1992) has word-final epenthesis of [ɛ]. Possibly relevant is the fact that other vowels are subject to cooccurrence restrictions but [ɛ] can cooccur with any other vowel.

In Gengbe (mentioned in the text), there are two kinds of epenthesis argued for. Initial epenthesis of e seems well supported. It appears that only [e] and [a] can be word initial, so if the epenthetic vowel has to be nonlow, [e] would be the only choice. They also argue for some cases of final epenthesis but these don't seem as definitive - they can equally well be seen as deletion rules.

Epenthesis of [u] is sometimes claimed to exist but it is unclear whether there are any cases that don't involve additional contextual conditioning. Epenthesis in Japanese loans is not a case if the high back vowel is unrounded. In addition, Japanese uses different vowels in different vocabulary strata and contextual concerns seem to be relevant: the use of [u] and [o] in loans instead of the [i] of the native strata allows all consonants in loan words to be realized without phonological modification. (Thanks to Junko Ito for this observation.)   The 'enunciative vowel' in Dravidian is sometimes [u], but it's not clear whether these cases are productive epenthesis; in the languages where there is real evidence for productivity

the vowel is [ɨ]. Fula has both [i] and [u] epenthesis; both appear to be morphologically conditioned (Paradis and Prunet 1989.) A remaining troublesome case is Tangale (Kidda 1993, Kenstowicz 1993). Although it is unclear how this affects the choice of the epenthetic vowel, there is definitely something unusual about the relevant phonology in Tangale, which involves deletion of a vowel in a rather odd context, which creates impermissible clusters, which must then be repaired by insertion of another vowel.

Notes
*Thanks to the audience at LP2002 for comments, especially Philip Spaelti, Junko Ito and Ingo Plage, and to Jose Elias for help with data.

1 Also See McCarthy and Taub 1992 for a review of problems with coronal underspecification.

2 For example: Rose 1993 notes central vowels are likely to be epenthetic where they occur, otherwise front vowels, otherwise a; argues front vowels are likely because the are coronal but doesn't explain the rest of the variablity. Kitto and de Lacy (to appear) observes that schwa is likely to be epenthetic, and if no schwa, i and a are common. Keren Rice's work surveys variabilty and explains it by different representational requirements; these connections to the system are not made. ɨ is the unmarked vowel in Charm and Govt theory. Beckman 1998 suggests that there is no universal markedness relationship between low and nonlow vowels.

3. Given the wide variety of vowel feature systems that have been proposed, there may be some theories in which these actually are rankings of features of the same class or along the same dimension, although I have not yet pursued this possibility.

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