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THE VOWELS OF PROTO UTO-AZTECAN

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0. The two major works presently available concerning the reconstruction of Proto Uto-Aztecan (PUA) are in substantial agreement with regard to the major outlines of the PUA sound inventory. In initial position, both Voegelin, Voegelin, and Hale (henceforth VVH) and Miller reconstruct the following proto consonants: *p *t *c *k *kʷ *ʔ *s *h *m *n *w *y; the essential validity of this reconstruction is easily confirmed by an examination of cognate sets.[1] Moreover, both VVH and Miller reconstruct a five vowel system for PUA and agree on *i, *a, *u, and *o to represent four of the proto vowels. For the fifth vowel, VVH reconstruct *ɨ (high central or back unrounded), while Miller reconstructs *e. I will argue in this paper that *ɨ is the proper reconstruction.[2]

Let us begin by examining the vowel correspondences that are attested to by cognate sets in the daughter languages. We will restrict our attention to ten daughters, Comanche (CM), Tübatulabal (T), Cahuilla (CA), Cupeño (CU), Luiseño (L), Hopi (H), Papago (P), Yaqui (Y), Cora (CR), and (Classical) Aztec (A). With the exception of the Takic or Southern California Shoshonean subfamily (which includes Cahuilla, Cupeño, and Luiseño, among others), each major subfamily of Uto-Aztecan is represented by just one language.[3]

The basic vowel correspondences are represented in Table 1. The cognate sets in Table 2 are offered only for illustrative purposes, since full documentation of the correspondences is provided by VVH and by Miller. The two numbers given after the rough gloss for each PUA form are the numbers of the cognate set in VVH and Miller respectively.[4]

[1] C. F. Voegelin, F. M. Voegelin, and Kenneth L. Hale, Typological and comparative grammar of Uto-Aztecan: I (phonology). IUPAL Memoir 17 (1962). Wick R. Miller, Uto-Aztecan cognate sets, UCPL 48 (1967).

We will restrict our attention mainly to initial syllables, which have been the most stable in the development of the daughters from PUA. VVH reconstruct *r, *l, and *ŋ in addition to the consonants listed, but these hardly occur at all initially. It should be noted that Miller, who was primarily interested in providing cognate sets in order to facilitate comparative work, does not claim to have made 'a reconstruction in the usual sense'; rather, "the starred forms in this monograph represent a shorthand notation to enable the reader to see what phonemes have been compared" (p. 6–7).

An abbreviated version of this paper was read before the Linguistic Society of America, 29 December 1969, San Francisco. William Bright, Margaret Langdon, and Sanford Schane have provided many helpful comments.

[2] Neither VVH nor Miller offers any argument for choosing one vowel or the other, but the problem of choosing between *ɨ and *e of course remains regardless of whether or not they intended to make a serious claim as to the quality of the fifth PUA vowel by their symbolism. Stress and vowel length, claimed to be distinctive for the daughters, have not been worked out for PUA; we will ignore them here.

[3] Cf. Sydney M. Lamb, The classification of the Uto-Aztecan languages: a historical survey, *in* William Bright (ed.), Studies in Californian linguistics, UCPL 34 p. 106–25 (1964).

[4] Supplementary forms have been taken from Jane H. Hill, A grammar of the Cupeño language, UCLA doctoral dissertation (1966); William

There is little difficulty in choosing a proto vowel to underlie each of the first four correspondences; *i, *a, *u, and *o are the obvious reconstructions. The fifth vowel is problematic, however. Either *ɨ or *e could reasonably be reconstructed given only the reflexes in the ten daughters. Four of the daughters display ɨ for this vowel, and four display e. Since each of the eight daughters with ɨ or e represents a different subfamily, the two vowels are found in the same number of subfamilies. If no further information were available, one could not make a strongly motivated choice between *ɨ and *e. On deeper examination, however, sufficient evidence can be found to justify choosing *ɨ.[5]

1. Two initial considerations seem to me to make *ɨ the more plausible reconstruction. Not everyone would necessarily agree, and I do not wish to attach any great weight to these considerations. It is interesting to note, however, that they reinforce the conclusion that will be drawn on the basis of more persuasive evidence.

One argument that one might advance to justify the reconstruction of *e rather than *ɨ concerns the notion of markedness. In reconstructing *e, the argument goes, one is postulating for PUA a simple, relatively unmarked vowel system of the type that occurs in many, many languages: *i *a *u *o *e. Reconstructing *ɨ, on the other hand, results in a highly marked and rather uncommon vowel system: *i *a *u *o *ɨ.

This argument is invalid, however, since it presupposes that greater weight should be accorded the degree of markedness for the proto language than for the daughters, and this runs directly counter to what we know (or what we think we know) about the nature of language change. The issue is not whether vowel systems with i a u o ɨ can exist—they clearly can (and Papago is an example). The proper question, rather, is whether it is more reasonable to posit sound changes leading TO or FROM such a system. In reconstructing the proto vowel system *i *a *u *o *ɨ, one is hypothesizing that this system developed historically to the less highly marked system i a u o e in a number of daughters. There is nothing implausible about such a development.[6] In reconstructing *e, however, one is committed to the more questionable view that the relatively unmarked system *i *a *u *o *e developed to the highly marked system i a u o ɨ in several daughters.

TABLE 1

PUA	*i	*a	*u	*o	*ɨ/e
CM	i	a	u	o	ɨ
T	i	a	u	o	ɨ
CA	i	a	u	i	e
CU	i	a	u	i	ə
L	i	a	u	e	o
H	i	a	o	ö	ɨ
P	i	a	u	o	ɨ
Y	i	a	u	o	e
CR	i	a	ɨ	u	e
A	i	a	i	o	e

A second consideration concerns vocalic conservatism. Three of the four daughters with ɨ for the fifth vowel (Comanche, Tübatulabal, and Papago) have retained the other four PUA vowels unchanged. Moreover,

Bright, The history of the Cahuilla sound system, IJAL 31.241–4 (1965); and William Bright and Jane Hill, The linguistic history of the Cupeño, *in* Dell Hymes (ed.), Studies in southwestern ethnolinguistics, p. 351–71, The Hague, Mouton (1967).

[5] The strongest evidence in favor of one vowel or the other would be likely to emerge from the comparison of comprehensive generative phonological analyses of the daughter languages. Except for Papago, however, little published work has been done along these lines. Cf. Kenneth Hale, Some preliminary observations on Papago morphophonemics, IJAL 31.295–305 (1965).

[6] In terms of geographical distribution, the languages with e are, by and large, located farther to the south than those with ɨ. Eric Hamp has suggested (personal communication) that the *ɨ > e change in these southern languages may reflect their greater contact with Spanish. However, William Jacobsen has observed (personal communication) that this consideration may be anachronistic.

three of the four daughters with e for the fifth vowel (Cahuilla, Cora, and Aztec) have altered one or more of the other four PUA vowels. The languages with ɨ, therefore, tend to be vocalically conservative, while those with e tend to be vocalically innovative. To the extent that these observations are considered relevant, they support the choice of *ɨ to represent the fifth vowel of PUA.

These considerations are not fully persuasive because they involve assumptions that have not as yet been adequately refined and justified. The first argument assumes that sound changes which lead to highly marked vowel systems are less common than those which lead to comparatively unmarked systems.[7] The second argument assumes that the notions 'vocalically conservative' and 'vocalically innovative' are viable ones. I do not claim that sound changes in the direction of greater markedness cannot occur, nor that a language must undergo several vocalic changes if it undergoes any at all; these claims would obviously be false.[8] If the above assumptions have any validity, we must speak in terms of tendencies and not in terms of inviolable rules. Consequently, *ɨ merits at best only tentative preference as the proper reconstruction on the basis of these considerations (even granting that the assumptions on which they rest are valid). For a fully convincing argument, we must turn to other sorts of evidence.

TABLE 2

PUA	*cipu bitter (13–43)	*pi breast (6–58)	*naka ear (47–148)	*waki dry (99–143)	*pusi eye (5–160a)	*ku fire (137–170a)	*wo two (103–509a)	*ʔoŋa salt (63–359)	*kɨ(ʔV)/ ke(ʔV) bite (43–42)	*tɨwa/tewa name (20–300a)
CM	—	picipɬ	naka-	—	pui	ku-	—	ʔona:-	kɨh-	—
T	—	pi:-	naⁿha-	wa:g-	puⁿẓi-	ku-	wo:	ʔoŋa-	kɨ:ʔ-	—
CA	—	-piʔ	naqa-	wax-	-puš	ku-	wih	ʔiŋ-	ke-	tew-
CU	čivə	-pi	naqa-	wax-	-puč	ku-	wih	ʔiŋ-	kəʔə	təwa
L	čivu-	-piʔ	naq-	wax-	-puš	ku-	weh	ʔeŋ-	koʔi-	—
H	ci:vo	pi:-	na:qa	la:qi	po:si	ko:-	lö:yöm	ʔöŋa	kɨ:ka	tɨŋʷa
P	siw	wipi	na:k	gaki	wuhi	ku:-	go:-	ʔon	kɨʔi	či:g-
Y	či:bu	pippi-	nakka	wa:ke	pu:si	—	wo:yi	ʔo:na	keʔe	tea
CR	cihivi	—	na-	wahči	hɨʔɨsi	—	—	ʔunah	-čeʔe	—
A	čiči:-	—	-nakas	wa:ki	i:š-	—	o:me	—	-ke:coma	—

[7] If change is generally in the marked-to-unmarked direction, one might ask how highly marked segments or sound systems could ever come about. Part of the answer, no doubt, is that marked segments frequently result from the merger of separate, contiguous segments. The sequence ku or kw is a natural source for the marked segment kʷ, for instance, and ɨ might easily result from ui and iu. (Notice, as a strictly hypothetical example, that the addition of ɨ by means of such a merger could change the relatively unmarked vowel system i a u o into the marked system i a u o ɨ.) A theory of phonological change must allow merger as a normal development, even if it treats the change of single segments in the direction of greater markedness as exceptional.

2. A number of the northern Uto-Aztecan languages, including Tübatulabal, Cahuilla, Cupeño, Luiseño, and Hopi, have undergone a sound change backing *k to q before non-high vowels:[9]

$$(1) \qquad *k > q \;/\; \_\left[\begin{matrix} V \\ -HIGH \end{matrix}\right]$$

This change, which can be viewed as an

[8] For example, *t > ɬ was an environmentally conditioned change in Aztec. If *ɨ is reconstructed for PUA, then Yaqui must have undergone the change *ɨ > e while retaining all the other PUA vowels.

[9] In Tübatulabal, the reflex of *k before non-high vowels is h. I assume that *k > q was the initial development, followed later by the change q > h. Nothing crucial hangs on this assumption.

assimilation in height, is illustrated by the following cognate sets; Comanche and Papago forms are given for purposes of comparison (the change did not occur in these languages).

PUA *ku *fire* (137–170a): CM ku-, T ku-, CA ku-, CU ku-, L ku-, H ko:-, P ku:-.
PUA *ki *house* (44–240a): CA ki-, CU ki-, L ki:-, H ki:-, P ki:.
PUA *katɨ / kate *sit* (42–381a): CM karɨ-, T hal?-, CA qal, CU qa, L qal-, H qatɨ, P ka:č.
PUA *ko *older sister* (-492a): CA -qis, CU -qismə, L -qe:?is, H -qöqa.

In order to capture the significant generalization, we must assume that (1) preceded certain vowel changes that occurred in Cahuilla, Cupeño, and Hopi. (1) must precede the change of *u > o in Hopi, since *k is retained in Hopi before this vowel. (1) must also precede the change of *o > i in Cahuilla and Cupeño; otherwise there would be no way to account for the fact that q occurs in the Cahuilla and Cupeño forms for 'older sister' but not in the forms for 'house'.

Since ɨ is a high vowel while e is a non-high vowel, sound change (1) may provide some evidence for reconstructing one or the other. How does the fifth PUA vowel behave with respect to sound change (1)? The answer is that it behaves like the high vowels *u and *i, not like the non-high vowels *a and *o. The following cognate set exemplifies this:[10]

PUA *kɨ(?V) / ke(?V) *bite* (43–42): CM kɨh-, T kɨ:?-, CA ke-, CU kə?ə, L ko?i-, H kɨ:ka, P ki?i.

This would seem to support the contention that the fifth PUA vowel was *ɨ and not *e. Some care must be taken in evaluating this evidence, however. The argument is not as strong as it might at first appear to be.

Tübatulabal and Hopi underwent the change backing *k to q, but the data from these languages cannot be used to justify reconstructing *ɨ rather than *e, even if one assumes that (1) is the correct formulation of the backing rule. Since the fifth PUA vowel is reflected as ɨ in these languages, it would be possible to reconstruct *e and to claim that *e changed to ɨ before backing occurred. Backing could still be described by the very general formula shown in (1). Therefore we must turn to Cahuilla, Cupeño, and Luiseño; these are the only languages undergoing backing in which the reflex of the fifth PUA vowel is non-high. We will make the argument in terms of Cahuilla, but analogous arguments can be made for Cupeño and Luiseño as well.

If *ɨ is reconstructed, the generalization expressed in (1) can be maintained. Table 3 displays the derivation of the Cahuilla reflexes of proto forms beginning in *k. By ordering the *ɨ > e change after backing, the latter can be given as in (1); (1) fails to apply in the last column, because *k precedes a high vowel at the time of its application. As noted above, the *o > i change of Cahuilla must follow (1) also, for otherwise there would be no way for (1) to distinguish the occurrences of ki in which it must apply from those in which it must not apply.

Suppose, on the other hand, that *e were reconstructed as the fifth PUA vowel. Since e is the Cahuilla reflex of this vowel, no change analogous to the *ɨ > e change in Table 3 is necessary. The derivations of the

[10] Unfortunately, this is the only cognate set representing more than one subfamily that illustrates the development of PUA *kɨ / ke in a language in which change (1) occurred.

Hill 1966 cites two forms that can be taken as the Cupeño reflexes of PUA *kɨ?V / ke?V, namely kə?ə *to itch* and qə?ə *to bite*; she cross-references them to indicate that they are probably related. Semantic specialization has evidently taken place, accompanied by phonological differentiation. kə?ə is the expected shape of the Cupeño reflex (or else the backing rule would be significantly different for Cupeño and the other languages in which it occurred), so this is the form given in the cognate set. The choice is not really crucial to the overall argument, though it does make things neater.

Cahuilla forms are shown in Table 4. Backing must not apply to *ke, but (1) is so formulated that it will apply to this form. Hence the reconstruction of *e as the fifth PUA vowel entails that (1) is not the proper formulation of the backing rule. Backing must apply before a and o, but not before u, i, or e. This version of the backing rule is given in (2).

$$(2) \qquad *k > q \; / \; \_ \begin{bmatrix} V \\ -HIGH \\ -FRONT \end{bmatrix}$$

With proper ordering, (2) is adequate to

TABLE 3

PUA	*ku	*ki	*kati	*ko	*ki
Backing (1)	—	—	qati	qo	—
*i > e	—	—	qate	—	ke
Other changes	—	—	qal	qi	—
CA	ku-	ki-	qal	-qis	ke-

TABLE 4

PUA	*ku	*ki	*kate	*ko	*ke
Backing (2)	—	—	qate	qo	—
Other changes	—	—	qal	qi	—
CA	ku-	ki-	qal	-qis	ke-

account for backing in all the languages where it occurs.

We see, therefore, that backing provides only very limited evidence for reconstructing *i rather than *e. Reconstructing *i allows us to posit (1) as the backing rule, while reconstructing *e forces us to adopt (2), which is more complex. However, the difference in complexity is very minor; (2) requires only one feature specification more than (1).[11]

[11] It is possible that the difference in complexity between (1) and (2) is only apparent. A rule backing k to q before non-high back vowels but not before non-high front vowels is quite natural phonetically, and it is perfectly conceivable that an adequate theory of markedness or phonological 'naturalness' would judge (2) to be no more complex than (1).

Consequently, although the considerations mentioned in this section and the previous one converge to favor *i, we still require more persuasive evidence. We will return to backing later in another context.

3. The strongest evidence for the reconstruction of *i rather than *e is provided by the vowel changes in the Takic or Southern California Shoshonean subfamily. We will compare the claims that must be made concerning Takic vocalic development when the two alternate vowels are reconstructed.

First let us suppose that *i is reconstructed, as in Table 5. Table 5 shows that each of the languages has undergone changes in two of the five reconstructed vowels, namely *o and *i. *o develops to i in Cahuilla

TABLE 5

PUA	*i	*a	*u	*o	*i
CA	i	a	u	i	e
CU	i	a	u	i	ə
L	i	a	u	e	o

and Cupeño, but to e in Luiseño. *i develops to e in Cahuilla and to o in Luiseño. The Cupeño reflex of *i is ə, a mid central unrounded vowel. These changes are summarized in Table 6.

At first glance, the three languages appear to have little in common with respect to the historical development of their vowel systems. Only one change is shared, and that is common only to Cahuilla and Cupeño; one would expect such closely related languages to show more shared innovations. However, Table 6 is little more than a statement of vowel correspondences between PUA and the three daughters. Implicit in Table 6 is the claim that each change came about in a single jump, i.e. that there were no intermediate stages between any proto vowel and its reflex. But there is no a priori reason to make this assumption. If we make the opposite assumption, namely that there were intermediate stages, a much more satisfying

picture emerges. Consider Table 7. The scheme in Table 7 assumes that *o developed to i through the intermediate stages ö and e: *o > ö > e > i. The first two steps occurred in all three languages, but the third was restricted to Cahuilla and Cupeño; Luiseño thus has e as the reflex of *o. Similarly, it is assumed that *i was lowered to ə in all three languages. ə was then fronted to e in Cahuilla and rounded to o in Luiseño.

This scheme has several advantages. First, it is much more plausible phonetically than the scheme in Table 6. It is most unlikely that the *o > i development involved no intermediate stages. Treating *i > e and *o > e as unmediated changes is similarly implausible on phonetic grounds.[12] All of the changes in Table 7 are phonetically plausible.

TABLE 6

Cahuilla—Cupeño	Luiseño
*o > i	*o > e
	*i > o
Cahuilla	**Cupeño**
*i > e	*i > ə

A second advantage of this view is that it postulates a greater number of shared innovations than its alternative. Notice that three of the six changes are shared by all three daughters, and a fourth by Cahuilla and Cupeño; only two changes are restricted to a single language. This scheme also accounts for the fact that the vocalic shifts in these languages are significantly similar in ways that go well beyond what one would expect on the basis of chance. In all three languages, sound changes have occurred that affect precisely two proto vowels, and they are the same vowels in every case. In all three daughters, *o becomes a front unrounded vowel. Furthermore, *i is lowered to a mid vowel in all three daughters. These similarities are in a sense explained by the revised scheme—they result as automatic consequences of the hypothesis of shared innovations. With the former scheme, all these similarities would have to be considered coincidental.

Third, it is possible (in fact, in most cases necessary) to order the changes so that shared innovations uniformly precede unshared innovations. The changes can be taken as occurring in the order shown in Table 7, though not every ordering relation is functional.

TABLE 7

Cahuilla—Cupeño—Luiseño	
*o > ö	
ö > e	
*i > ə	
Cahuilla—Cupeño	**Luiseño**
e > i	ə > o
Cahuilla	**Cupeño**
ə > e	—

Still a fourth advantage is that there is direct evidence for all of the postulated intermediate stages, evidence that could not be explained or exploited in any natural way in terms of the former scheme. ə is postulated as an intermediate stage in Cahuilla and Luiseño, but it is the final stage in Cupeño; the scheme in Table 6 would have no way of relating the occurrence of ə in Cupeño to the fact that the other two languages also have mid vowels as the reflex of *i. Evidence for the postulated *o > ö development is provided by Hopi; ö is the regular Hopi reflex or *o (e.g. PUA *ʔoŋa *salt* (63–359) > Hʔöŋa). Thus we know that the change

[12] In hypothesizing that these changes involved intermediate stages, I am not subscribing to the 'classical' view of sound change, which holds that sound change is the result of indefinitely many successive minuscule increments of articulatory slippage. Rather, it is claimed that a small, finite number of discrete changes (two or three) may underlie a change such as o > i, each change originating as the addition of a rule to the phonological component.

*o > ö did occur in a geographically contiguous Uto-Aztecan language.[13] There is also direct evidence for the intermediate stage e in the postulated sequence of events *o > ö > e > i. Not only is e the reflex of *o in Luiseño, but it is also the Cahuilla reflex in at least one environment. The Cahuilla change e > i evidently failed to apply before x, as shown by examples such as these: PUA *woko *pine* (142–320a) > CA wexe-; PUA *koka *beads* (–28) > CA qenxa- (origin of n unknown); CA nexi- *gourd* (cf. CU nixi-, L ne:xi-). The existence of such forms is not terribly surprising in terms of the scheme in Table 7, but there is no natural way to account for them in terms of the one in Table 6.

We see, therefore, that reconstructing *ɨ leads to a rather satisfying picture of the historical development of the PUA vowels in Takic. The sound changes can be broken down into a series of small, phonologically plausible steps. Half of the changes are shared by all three languages under consideration, and another is shared by Cahuilla and Cupeño (one of these changes is further attested in Hopi and Serrano); the significant similarities in the vocalic development of these three languages are thus accounted for. All of the shared innovations precede all of the unshared innovations. Finally, evidence can be adduced to justify all of the postulated intermediate stages.

Reconstructing *e, on the other hand, leads to certain difficulties. The correspondences to be accounted for are given in Table 8. Once again, there are two options; we can hypothesize that changes such as *o > i came about in a single step, or we can hypothesize that they involved intermediate stages. With the former alternative, we have the situation represented in Table 9.

At first the reconstruction of *e might seem to have certain advantages. For one thing, there is no need to postulate the change *ɨ > e for Cahuilla; only one change is needed for Cahuilla in Table 9, therefore, while two are needed in Table 6. However, this is not a valid argument, because reconstructing *e entails a corresponding complication of the sound changes needed for other languages. Four of the daughters under consideration have e as the reflex of the fifth PUA vowel, it will be recalled, and four have ɨ. Thus, no matter which vowel we reconstruct, four daughters will have a sound change shifting e to ɨ or vice versa.

TABLE 8

PUA	*i	*a	*u	*o	*e
CA	i	a	u	i	e
CU	i	a	u	i	ə
L	i	a	u	e	o

TABLE 9

Cahuilla—Cupeño	Luiseño
*o > i	*o > e
	*e > o
Cahuilla —	**Cupeño** *e > ə

Another initially tempting feature of Table 9 is the possibility of collapsing the two Luiseño changes into one, i.e. claiming that *o > e and *e > o occurred simultaneously by the addition of a single 'alpha switching' rule to the phonological component. However, this hypothesis has a number of drawbacks. First, it is not at all certain that it is linguistically possible for a sound

[13] ö is also the Serrano reflex of *o (cf. Miller 1967); Serrano is a Takic language somewhat more distantly related to Cahuilla, Cupeño, and Luiseño than the latter are to one another. Thus ö is directly attested as one stage in the development of *o even if we restrict ourselves to this one subfamily.

change of this type to occur.[14] Secondly, assuming that such a change is possible, treating *o > e and *e > o as a single development leaves us unable to explain the similarities between the development of *o in Luiseño and in various other languages. The fact that *o became an unrounded front vowel in the three Takic languages is treated as just a coincidence. Moreover, the parallelism with the *o > ö change in Hopi and Serrano is lost.

To overcome these difficulties, one might discard the scheme in Table 9 in favor of the one given in Table 10; various alternatives are possible, but any obvious alternative will serve equally well for purposes of this argument. In Table 10, it is hypothesized that *o developed through ö to e in all three languages—these were shared innovations. e subsequently changed to i in Cahuilla and Cupeño, but another development took place in Luiseño. In Luiseño, the ö > e rule was generalized to an alpha switching rule that interchanged all occurrences of ö and e. The new occurrences of ö (from *e) were then changed to o. Table 10 is preferable in several ways to Table 9. For one thing, a rule interchanging ö and e in all environments seems more plausible than one interchanging o and e (since only rounding is involved, not both rounding and gravity). Furthermore, Table 10 expresses some of the previously noted similarities in the vocalic development of the three languages. Finally, Table 10 posits the intermediate stages ö and e, which are well motivated, as we saw earlier.

TABLE 10

Cahuilla—Cupeño—Luiseño		
*o > ö		
ö > e		
Cahuilla—Cupeño		Luiseño
e > i		ö > e rule generalized to
Cahuilla	Cupeño	[ö > e *e > ö]
—	*e > ə	ö > o

However, the scheme in Table 10 also has several disadvantages (even leaving aside the rather subjective criticism that it seems contrived). The Luiseño changes still look suspicious, particularly the ö > o change; while it is common for o to be fronted to ö in natural languages, the converse development is at best unusual.[15] Ordering presents another difficulty. The Cupeño change *e > ə must be ordered before the ö > e change (otherwise there would be no way to prevent a merger that did not in fact take place). But *e > ə is restricted to Cupeño, while the change that it must precede is an innovation common to all three languages. When *e is reconstructed, therefore, it is not possible to order the changes so that all shared innovations precede all unshared innovations.

Cahuilla presents a much more serious problem. There is, as we have seen, very

[14] I am not denying the existence in natural languages of alpha switching rules (rules that interchange segment types). Typically, however, such rules are integrated in the morphophonemics of a language and involve the switching of only one feature; more often than not, two adjacent vowels in the front series or in the back series are interchanged. What would have to be posited for Luiseño is a rule that is apparently independent of morphophonemic processes (hence quite sweeping in its effects), that operates between the front and back series, and that flips two features (gravity and rounding) instead of one. I am not asserting that such rules are impossible, only that their possibility is not obvious and has yet to be demonstrated.

[15] One way to avoid this difficulty would be to claim that Luiseño underwent the *e > ə rule posited for Cupeño (instead of the generalization of ö > e to an alpha switching rule). One problem with this solution is that one is forced to posit a rather unusual vowel system for one intermediate stage in Luiseño: i a u ö ə. Furthermore, it has been argued on independent grounds (Bright and Hill 1967) that Cahuilla and Cupeño constitute a subfamily within Cupan, the larger subfamily that includes all three languages; an innovation common to Cupeño and Luiseño but not shared by Cahuilla runs counter to this hypothesis of genetic relationship.

good evidence to the effect that *o developed to i in Cahuilla by the route *o > ö > e > i. The Cahuilla reflex of the fifth PUA vowel is e, however, and if *e is reconstructed for this fifth vowel, then *o could not have passed through the intermediate stage e in developing to i. If it had, *o and *e would have merged in Cahuilla, but in fact they did not. Consequently, we must abandon the *o > ö > e > i scheme in favor of something else, the most likely candidates being *o > ö > i and *o > ö > ü > i. Neither is really satisfactory, however. Not only do they fail to posit for Cahuilla the same changes that occurred in Cupeño and Luiseño, but they also fail to account for the forms, cited earlier, in which e is the Cahuilla reflex of *o.[16] None of these difficulties arises when *i̇, rather than *e, is reconstructed as the fifth PUA vowel.

4. I think it is fair to conclude on the basis of the above arguments that *e is not the proper reconstruction for the fifth vowel of PUA. I also conclude that *i̇ is perfectly satisfactory as the reconstruction and represents the natural choice in view of the fact that numerous daughter languages have i̇ as the reflex of this fifth proto vowel. However, there is another candidate that might be considered, namely ə (a mid central unrounded vowel), which is the Cupeño reflex. Indeed, Kenneth Hill has recently proposed *ə as the proper reconstruction.[17] The difficulties that arise when *e is reconstructed do not arise when *ə is reconstructed, so Hill's proposal cannot be rejected out of hand. Nevertheless, I will try to show that there are good grounds for preferring *i̇ to *ə.

The only argument that Hill gives for reconstructing *ə rather than *i̇ concerns the system of distinctive features needed to distinguish the proto vowels. If i̇* is reconstructed, three distinctive features are needed to differentiate the five proto vowels, the features of height, rounding, and fronting, as shown in Table 11; note that the front-back feature serves only to distinguish

TABLE 11

	*i	*i̇	*u	*a	*o
HIGH	+	+	+	−	−
ROUND	−	−	+	−	+
FRONT	+	−	0	0	0

*i and *i̇, being redundant for the other vowels. On the other hand, reconstructing *e leads to the vowel system shown in Table 12, which is the system Hill proposes. Hill argues that the system in Table 12 is preferable to the one in Table 11 because the distinctive character of the front-back feature for PUA is very dubious. He states that the rounded vowels of PUA were indifferently front or back. *o was phonetically a front vowel in the area of Arizona and Southern California (since *o is reflected as a front vowel in Hopi and the Takic languages), and *u was apparently a front vowel phonetically in the far south (the

[16] It is of course possible to maintain the *o > ö > e > i scheme if one is willing to pay a high enough price. One option is to claim that *e changed to some other vowel in Cahuilla, perhaps æ; after the *o > ö > e > i development, æ changed back to e. The rather abstract view of phonological systems countenanced by generative phonology makes other options available. For example, one could claim that æ was the underlying vowel in PUA, with e being only the surface manifestation of æ, and that this is still the situation in Cahuilla. With proper (synchronic) rule ordering, then, *o > ö > e > i could have taken place without the merger of *o and *e. Both these options require completely ad hoc constructs, of course, and the latter clearly abuses the conceptual apparatus of generative phonology. I know of no way of altering the conclusions reached in this paper by means of a heavier reliance on the use of abstract underlying representations without resorting to completely ad hoc constructs and / or violating reasonable constraints on phonological systems.

[17] Some implications of Serrano phonology, *in* Robert I. Binnick et al. (eds.), Papers from the fifth regional meeting of the Chicago linguistic society, Department of Linguistics, University of Chicago p. 357–65 (1969).

Aztec reflex of *u is i). Hill claims that the front-back feature was therefore not distinctive for PUA. This entails that *i cannot be the proper reconstruction, since *i and *ɨ would be distinguished solely by this feature. Moreover, if PUA had both *i and *ɨ, which differ in only one feature, one would expect them to merge in a number of daughters, but in fact this happened rarely if at all.

This is not a valid argument. Hill's assumptions concerning the phonetic character of the proto vowels are gratuitous. The fact that *o developed to a front vowel in two subfamilies while *u developed to i in another subfamily simply does not entail that the rounded vowels of the proto language were indifferently front or back. It is perfectly possible that the rounded vowels of PUA were phonetically back, and that fronting occurred through the sound changes *o > ö and *u (> ü) > i in certain daughters. Even if one were to make the unmotivated assumption that the degree of fronting was free for rounded vowels in PUA, this would not simplify in any way our account of the historical development of the PUA vowels; such sound changes as *o > ö and *u (> ü) > i would still have to be postulated in order to account for the fact that the degree of fronting ceased to be free in the various daughters. So far as the efficient use of distinctive features is concerned, Tables 11 and 12 are equivalent. The front-back feature serves only to distinguish *i and *ɨ in Table 11, but the feature low serves only to distinguish *ə and *a in Table 12. It is apparent that a five-vowel system requires at least three distinctive binary features, and it is equally apparent that the third feature will not have much work to do, regardless of how one slices the loaf. Finally, there is no force at all to the argument that *i and *ɨ, differing in only one feature, would have merged in some daughters if *ɨ were the proper reconstruction. There is no particular reason to expect such a merger, and in any case, an exactly analogous argument applies to the vowel system that Hill himself proposes. In Table 12, *ə and *a differ only in one feature; according to Hill's own assumptions, therefore, these two vowels should have merged in a number of daughters, but in fact they did not.

TABLE 12

	*i	*ə	*u	*a	*o
HIGH	+	−	+	−	−
ROUND	−	−	+	−	+
LOW	0	−	0	+	0

Although no valid argument in favor of *ə has been advanced, it is not hard to find some arguments against this reconstruction. On strictly numerical grounds, *ɨ must be preferred as the proper reconstruction. Many daughter languages have ɨ as the reflex of the fifth proto vowel, but only one—Cupeño—has ə. Fewer sound changes are thus required if *ɨ rather than *ə is reconstructed. In addition, the languages with ɨ are in general vocalically conservative, as noted earlier. Cupeño has undergone other vowel changes, so that it does not seem at all unreasonable to suppose that ə is innovative in Cupeño as well. However, these are weak arguments at best; let us turn to evidence of another sort.

Such evidence is provided by the interaction of the fifth PUA vowel with the backing rule, which was discussed in **2**. It will be recalled that the backing rule, which backs k to q before certain vowels, can be given as formula (1) if *ɨ is reconstructed.

$$(1) \qquad *k > q \;/\; \_\begin{bmatrix} V \\ -HIGH \end{bmatrix}$$

The derivation of the Cahuilla reflexes of PUA forms in *kV was given in Table 3.

This time let us consider Luiseño (analogous arguments can be given in terms of the other Takic languages under consideration). If *ɨ is reconstructed, the derivation of the Luiseño reflexes of proto forms in *kV will

proceed as in Table 13. By ordering the backing rule before the rule lowering *ɨ to ə, it can be given in the very general form shown in (1)—backing occurs before non-high vowels and only there.

However, we cannot make this generalization if *ə is reconstructed. Let us assume for the moment that backing occurred before *ə changed to o. The derivation of the Luiseño forms will then be as shown in Table 14. In terms of Table 14, the backing rule cannot be given as (1). Rule (1) specifies that backing occurs before all non-high vowels, but ə

TABLE 13

PUA	*ku	*ki	*katɨ	*ko	*kɨʔi
Backing (1)	—	—	qatɨ	qo	—
*o > ö > e	—	—	—	qe	—
*ɨ > ə > o	—	—	qato	—	koʔi
Other changes	—	ki:	qal	qe:	—
L	ku-	ki:-	qal-	-qe:ʔis	koʔi-

TABLE 14

PUA	*ku	*ki	*katə	*ko	*kəʔi
Backing (3)	—	—	qatə	qo	—
*o > ö > e	—	—	—	qe	—
*ə > o	—	—	qato	—	koʔi
Other changes	—	ki:	qal	qe:	—
L	ku-	ki:-	qal-	-qe:ʔis	koʔi-

is a non-high vowel, and backing does not occur before ə. Thus the backing rule must be reformulated so that it will apply before a and o, but not before u, i, or ə. Unfortunately, there is no single feature that divides the five vowels in this way—the environment for backing must be specified disjunctively, as in (3) or (4).

(3) $$*k > q / \_ \begin{bmatrix} V \\ -HIGH \\ \begin{Bmatrix} [+ROUND] \\ [+LOW] \end{Bmatrix} \end{bmatrix}$$

(4) $$*k > q / \_ \begin{bmatrix} V \\ \begin{Bmatrix} [+LOW] \\ \begin{bmatrix} -HIGH \\ +ROUND \end{bmatrix} \end{Bmatrix} \end{bmatrix}$$

It is clear that (3) and (4) do not capture the significant generalization; they fail to express the regularity that is simply and naturally expressed in (1).

The situation is no better if we assume that backing occurred after *ə was rounded to o. Under this assumption, the Luiseño changes would be those in Table 15. Notice that the fronting of *o must precede the rounding of *ə to o in order to prevent merger. The scheme in Table 15 is undesirable in several respects. For one thing, it claims that the widespread backing rule followed the changes affecting *o and *ə. However, *o > ö is restricted to the Takic languages (and Hopi) and *ə > o is restricted to Luiseño. This ordering is therefore in conflict with the ordering that one would expect on the basis of genetic relationships. A

TABLE 15

PUA	*ku	*ki	*katə	*ko	*kəʔi
*o > ö > e	—	—	—	ke	—
*ə > o	—	—	kato	—	koʔi
Backing (5)	—	—	qato	qe	—
Other changes	—	ki:	qal	qe:	—
L	ku-	ki:-	qal-	-qe:ʔis	koʔi-

further difficulty is that no simple, natural formulation of the backing rule can be given. Backing must apply before a and e, but not before u, i, or o, and there is no single feature that can be used to specify just a and e. The backing rule must be given as in (5).

(5) $$*k > q / \_ \begin{bmatrix} V \\ -HIGH \\ -ROUND \end{bmatrix}$$

Not only is (5) more complicated than (1), but it is also much less plausible phonetically.

5. Three candidates have been proposed for the reconstruction of the fifth PUA vowel, *ɨ, *e, and *ə. No convincing argument has been advanced for either *e or *ə, and both of these reconstructions lead to

certain difficulties. The most serious difficulty with *e is that this choice prevents one from postulating the development *o > ö > e > i to account for the occurrence of i as the Cahuilla reflex of *o; there is fairly conclusive evidence that *o did in fact develop to i in Cahuilla via this route. The most serious difficulty with reconstructing *ə is that this choice makes it impossible to give a simple, phonetically natural specification of the rule backing *k to q before certain vowels. No difficulties arise if *i̵ is reconstructed as the fifth PUA vowel, and this reconstruction leads to a simple, phonetically natural view of the sound changes affecting the PUA vowels in Takic which has the further advantage that shared innovations uniformly precede unshared innovations. All of the evidence converges to favor *i̵, both the informal considerations of plausibility and the more substantive arguments. I think it is fair to conclude that *i̵ is the proper reconstruction on the basis of the evidence that is currently available.