

THE VOWEL SYSTEM OF PERO

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The paper is a synchronic description of the vowel system in Pero, a West Chadic language. It has been found that the features high, low, and round are the only distinctive features necessary to describe the underlying vowels. The main characteristic of this vowel system is extensive neutralization of these features, which results in a large number of phonological alternations. The description provides the rules to account for all of the phonological alternations to be found in the verbal system and thus accounts for most of the alternations to be found in the language.

1. Introduction

The purpose of this paper is to describe the vowel system of Pero, a West Chadic language.¹ The interest that this vowel system may present to a scholar involved in Chadic, Afroasiatic, or general linguistics are massive processes of neutralization of the distinctive features. The main result of this description is the explanation of phonological alternations. The description is synchronic and consists of postulating underlying vocalic segments, rules which insert segments not present in the underlying form, and rules to account for the phonetic realization of the underlying and inserted segments. The morpheme structure conditions affecting vowels will be introduced when the rules relating to them are discussed. Frequent reference will be made to the consonantal system, described in Frajzyngier

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[1978], because of the interrelationship between vowels and consonants in Pero, which affects both systems.

2. Underlying and Phonetic Vowels

The following are postulated as underlying vocalic segments for Pero:

	i	e	a	o	u	ii	ee	aa	oo	uu
High	+	-	-	-	+	+	-	-	-	+
Low	-	-	+	-	-	-	-	+	-	-
Round	-	-	-	+	+	-	-	-	+	+
Long	-	-	-	-	-	+	+	+	+	+

Postulating the existence of the distinctive feature [round] rather than the features [back] or [front] captures the fact that vowels /i/, /a/, and /e/ constitute in Pero a class opposed in its phonological behaviour to the class /o/ and /u/. The distinctive features [back] or [front] would not capture this fact. In the description of the phonetic realization of some segments it will be necessary, however, to use the redundant feature [back]. The importance of the natural classes determined by the value of the feature [round] will be seen in the discussion of the rules of lowering and raising.

The set of phonetic vowels contains the underlying vowels as listed above plus a high central vowel [ɨ] to be described in the section dealing with the neutralization of the feature [round].

3. Epenthetic Vowels

In addition to the vowels derived from the underlying segments there are vowels in Pero which are inserted by rule. The constraints that require vowel insertion are of two kinds: (a) syllable structure constraints and (b) consonant cluster constraints. Although it is mechanically possible to formulate rules which would include the consonant cluster constraint as a particular type of syllable structure constraint, the conditions of this constraint have nothing to do with syllable structure, but rather with the phonological features present in the consonants involved.

The following syllable structures which are not allowed in Pero are pertinent to the rules of vowel insertion:

1. syllables of the structure (C)V^{C}_{V}CC;
2. syllables of the structure CCV(C) in which the first consonant is not a nasal.

The following consonant clusters, which are not allowed in Pero, require a vowel insertion:

3. [-back]^C [+back]^C, i.e. clusters such as -p^Ck-, -b^Cg-, -v^Cγ-, -d^Cg-.

Another type of cluster is the one which has in the first or second position [j] (= IPA dʒ). The following is the formulation of this constraint in terms of features:

4. [-nasal]^C [+palatal]^C
5. [+palatal]^C C

Clusters in which the first consonant is a nasal and the second is [j] are allowed.

Although there are several types of constraints that require insertion of a vowel, the quality of the epenthetic vowel is determined by the same conditions regardless of the type of constraint. The only environment which does not naturally determine the quality of the epenthetic vowel is described by the following rule:

Rule 1. EPENTHESIS I

$$\emptyset \rightarrow \left[\begin{array}{c} V \\ +\text{high} \\ +\text{round} \end{array} \right] / C_C\#\#$$

The rule states that [u] is inserted in order to break a word final (hence syllable final) consonant cluster.

- | | | | | | |
|-----|--------|-----|---|---|--|
| à | dén | m | → | [àd ^h dén ^h ù ^h m] | (for consonantal changes see Frajzyngier [1978]) |
| neg | bitter | neg | | | |
| à | dín | m | → | [àd ^h dín ^h ù ^h m] | |
| | black | | | | |
| à | tóm | m | → | [àróm ^h ù ^h m] | |
| | blood | | | | |
| à | ám | m | → | [áám ^h ù ^h m] | |
| | water | | | | |

The claim that there is nothing in the environment that predicts that the epenthetic vowel is [u] is based on the fact that it is inserted regardless of the quality of the preceding vowel. One could conceivably claim that it is the consonantal suffix [m] which determines the quality of the epenthetic vowel, and unfortunately there is no other consonantal suffix added to the stems ending in a consonant by which one might test this hypothesis.

An alternative solution would be to postulate /a...um/ as the underlying form of the negative morpheme, i.e. instead of postulating insertion of [u] one would postulate its existence in the underlying representation. This would in turn require a rule deleting /u/ whenever it is preceded by a vowel, e.g.

à gbándì um → [àgbándìm]
neg baobab neg

Assuming that the underlying form of the negative contains /u/ one would have to postulate the following rule to account for the deletion as in the example above.

Rule 2. VOWEL ELISION

V → Ø / V+___

The rule says that a vowel is deleted when preceded by another vowel in a different morpheme. The rule, however, is not otherwise supported in the language as there are vocalic suffixes which when added to morphemes ending in a vowel do not cause deletion of this vowel. Such is the case with the definite suffix -i .

In the remaining environments the quality of the epenthetic vowel is determined either by the quality of the preceding vowel (when the appropriate vocalic and consonantal environment is met) or by the quality of the following vowel (in all other environments). The following rule is written with the intention that its subparts be applied in order from top to bottom, i.e. first, application to the narrower environment, then to the wider:

Rule 3. EPENTHESIS II

$$\emptyset \rightarrow \left[\begin{array}{c} V \\ +\text{high} \\ -\text{long} \\ \langle \text{}_1\text{-round}_1 \rangle \\ \langle \text{}_2\text{around}_2 \rangle \end{array} \right] / \left\{ \begin{array}{l} \left[\begin{array}{c} V \\ +\text{high} \\ \langle \text{}_1\text{-round}_1 \rangle \end{array} \right] C \quad C \quad \overline{C} \\ \quad \quad \quad \quad \quad \quad \langle \text{}_1+\text{pal}_1 \rangle \quad \langle \text{}_1+\text{pal}_1 \rangle \\ \overline{\$} C \quad C \quad V \\ \quad \quad \quad \quad \quad \quad \langle \text{}_2\text{around}_2 \rangle \\ C \quad CC \quad V \\ \quad \quad \quad \quad \quad \quad \langle \text{}_2\text{around}_2 \rangle \end{array} \right\}$$

where $\overline{\$}$ in line 2 is a syllable containing a long vowel or ending in a nasal or a consonant identical to the next consonant

The top line of the rule says that *i* is inserted between two palatal consonants which are preceded by the sequence *iC*, regardless of the vowel in the following syllable:

wícc- j- → [wíccíjò] 'burn it (pl.)!
burn pl [IMPERATIVE]

The second and third lines say that the epenthetic vowel will agree in roundness with the following vowel. In the second line, a vowel is inserted between consonants following a heavy syllable provided that syllable contains a long vowel or ends in a nasal or a consonant identical to the next consonant (i.e. NC and C_1C_1 behave as inseparable clusters).

túul- scatter	kò Perf	→	[túulúgò]	'he scattered'	
báan- look	kò Perf	→	báanúkò	R-14 → [báanóyò]	'he looked'
pénj- see	j- pl	→	[pénjújò]	'see many' [IMPERATIVE]	
ádd- eat pl	-tù Vent	→	[áddúrù]	'eat many and come'	
ádd- eat pl	-jì Häb	→	[áddíjì]	'always eat many'	

The third line says that elsewhere when three or more consonants occur in a row, insert a high vowel agreeing in roundness with the next vowel before the last two consonants (see below, following Rule 8, for some examples).

Postulating the existence of epenthetic vowels in Pero allows us to explain several facts that have remained unexplained so far. The first of them pertains to the formation of plural verbs and the other to the vowel alternations. There is a group of verbs which have the first syllable light and a sonorant as the first consonant of the second syllable. The formation of the plural forms for such verbs can be represented by the following rule:

Rule 4. PLURAL VERB FORMATION

$$C_1VC_2 \begin{matrix} V \\ [+son] \end{matrix} \rightarrow C_1VC_1C_1C_2- \text{ [PLURAL]}$$

This rule produces a syllable structure unallowed in Pero. By Rule 3, [i] or [u] is inserted to produce syllable structures that are allowed:

pín- wash	$\xrightarrow{R-4}$	píppn-	$\xrightarrow{R-3}$	[píppúnò] [IMPERATIVE]
mén- like	\rightarrow	mémnn-	\rightarrow	[mémnúò] [IMPERATIVE]
mír- remember	\rightarrow	mímmr-	\rightarrow	[mímmúrò] [IMPERATIVE]
jír- steal	\rightarrow	jíccr-	\rightarrow	[jíccúrò] [IMPERATIVE]

The plural forms of the roots or stems that already have a consonant cluster in the middle position is formed by addition of the phonologically conditioned suffixes -j- or -t-. Addition of a consonantal suffix to a consonant cluster once again produces an unallowed syllable structure and therefore requires insertion of a vowel as formulated in Rule 3:

yímm- think	-j- Pl	\rightarrow	yímmj-	$\xrightarrow{R-3}$	[yímmújò] [IMPERATIVE]
yémm- carve	-j- Pl	\rightarrow	yémmj-	\rightarrow	[yémmújò] [IMPERATIVE]
wácc- scatter	-j- Pl	\rightarrow	wáccj-	\rightarrow	[wáccújò] [IMPERATIVE]
càdǎ- carry	-t- Pl	\rightarrow	càdǎt-	\rightarrow	[càdǎúrò] [IMPERATIVE]
dǎll- fetch water	-t- Pl	\rightarrow	dǎllt-	\rightarrow	[dǎllúrò] [IMPERATIVE]

Thus the rule accounts for the presence of the same vowel (in the examples above it is [u]) in various forms of the plural verbs. But it also accounts for the vowel alterations. The forms above are quoted in the imperative which in all of these verbs has a back vowel. If however there is a non-back vowel following the epenthetic vowel the epenthetic vowel is non-back:

càdd-	-t-	-jì	→	[càddí'rjì]	'always carry many'
carry	Pl	Habit			
pénj-	-j-	-nà	R-6,3	[pénj'jínà]	'saw many and came'
saw	Pl	Perf			
		Vent			
			cf.	[pénjújò]	'see many!'
				[IMPERATIVE]	
cámm-	-j-	-jì	→	[cámmí'ccì]	'always make many ropes'
make a	Pl	Habit			
rope			cf.	[cámmújò]	'make many ropes!'
				[IMPERATIVE]	

The conditions governing the quality of an epenthetic vowel when it is inserted to break an unallowed consonant cluster are the same as in Rule 3. The rule to account for constraint 3 (p. 41) has the following form:

Rule 5. EPENTHESIS III

∅	→	$\left[\begin{array}{c} V \\ +\text{high} \\ -\text{long} \\ \text{around} \end{array} \right]$	/	$\frac{C}{[-\text{back}]}$	$\frac{C}{[+\text{back}]}$	$\frac{V}{[\text{around}]}$		
túr-	-kò-	R-5	→	/túrukò/	R-14	→	[túróyò]	'climbed'
climb	Perf							
kúb-	-kò-	R-5	→	[kúbúgò]				'tasted'
taste	Perf							
kúd-	-kò-	R-5	→	[kúdíúgò]				'refused'
refuse	Perf							
kúd-	-kò-	R-5	→	[kúdí'géénì]				'he refused'
refuse	Perf	ée ²	nì					
		Pre- ₂	ICP					
		Pron						

²The insertion of -ee- is required in certain cases when a verb is followed by a pronominal suffix. A description of the phenomenon in Pero and other West Chadic languages is the subject of a publication in preparation.

The derivation of the phonetic form immediately above requires the application of the following ordered rules:

Underlying	/kú ^h kò ée nì/	
R-2 VOWEL ELISION	kú ^h k ée nì	
R-5 EPENTHESIS III	kú ^h í k ée nì	
STOP VOICING		
(See Frajzyngier [1978])	[kú ^h í géenì]	'he refused'

Thus the rule of epenthesis allows us to explain and therefore predict the vowels in different inflectional forms.

The rule to account for epenthetic vowels resulting from constraints 4 and 5 (p. 41) have the following form:

Rule 6. EPENTHESIS IV

$$\emptyset \rightarrow \left[\begin{array}{c} V \\ +\text{high} \\ \text{around} \\ -\text{long} \end{array} \right] / \left\{ \begin{array}{l} \begin{array}{ccc} C & \text{---} & C & & V \\ [-\text{nasal}] & [+palatal] & [\text{around}] & & \end{array} \\ \begin{array}{ccc} & & C & \text{---} & C & & V \\ [+palatal] & & & & & & [\text{around}] \end{array} \end{array} \right\}$$

(NB: [j] is the only [+palatal] intervocalic consonant)

ád ^h - eat	-jì- Habit	→	[ádíjì]	'always eat'
káp- talk	-jì- Habit	→	[kávíjì]	'always talk'
cúg- fall down	-jì- Habit	→	[cúgíjì]	'always fall down'
túr- climb	-jì- Habit	→	[túríjì]	'always climb'
káj- move	-kò- Perf	→	[kájóyò]	'moved'
máj- ask	-kò- Perf	→	[májóyò]	'asked'

In the last two examples, the rule VOWEL LOWERING IV (see p. 55) applies to the epenthetic [u].

$$\text{péj-} \quad \text{-tù-} \quad \xrightarrow{\text{R-18a}} \quad \text{píjtù} \quad \xrightarrow{\text{R-6}} \quad [\text{píjútù}] \quad \rightarrow^* \quad [\text{píjúrù}] \quad \text{'thatch and come'}$$

*STOP → CONTINUANT [Frajzyngier 1978]

4. Neutralization of the Contrast [+round] vs. [-round]

As in many West Chadic languages (cf. Schuh to appear) the contrast between front and back high vowels is not very stable. In Pero there are instances of free variation between short /i/ and /u/ within the same dialect, e.g. túccò and tíccò 'pound' as well as variation between dialects, e.g. Filiya [píðì], Gwandum [fúðì] 'place' ([f] is a realization of /p/ before back short vowels, cf. Frajzyngier [1978])

The neutralization of the feature [round] may occur in Pero as a result of two processes. The first process is the assimilation of /i/ → [u], and the second process involves changes in the feature [back], which is a redundant feature for Pero vowels. This process will be labeled "centralization". By this process both /i/ and /u/ become [ɨ] in certain environments.

In both dialects on which the present study is based the following rule accounts for the neutralization of the feature [round] before a round glide or a round vowel preceded by a sonorant. The round glide may or may not be preceded by a sonorant.

Rule 7. ROUNDNESS ASSIMILATION

$$V \rightarrow [+round] / \text{---} \left(\begin{array}{l} [+cons] \\ [+son] \end{array} \right) \left[\begin{array}{l} -cons \\ -voc \\ +round \end{array} \right] \left[\begin{array}{l} +cons \\ +son \end{array} \right] \left[\begin{array}{l} -cons \\ +voc \\ +round \end{array} \right]$$

Examples of /i/ → [u] / ___ ($\begin{array}{c} C \\ [+son] \end{array} \end{array})_w$:

nì + wé + kò $\xrightarrow{R-7}$ [nùwéyò] $\xrightarrow{R-21}$ [nùéyò] 'I saw'
I see Perf

cì + wé + kò → [šùwéyò] 'you saw'
you(f) see Perf

([š] is a variant of /c/ occurring before a sequence [-cons][-cons], cf. Frajzyngier [1978])

nì + n + wécc- + nà → [nùnwéccínà] 'I roasted and came'
I Conj roast Perf Vent

Example of /i/ → [u] / ___ C V :
 [+son][+round]

nì tódd- kò → [nùròddòyò] 'I cracked'
 I crack Perf

In the derivation of the phonetic form, the rule of assimilation is preceded by the rule STOP → CONTINUANT which creates the necessary sonorant. The complete derivation of this form has to include the following rules:

R-3 EPENTHESIS II nì tódd- u- kò
 R-14 VOWEL LOWERING III nìtóddòkò
 STOP → CONTINUANT nìróddòyò [Frajzyngier 1978]
 R-7 ROUNDNESS ASSIMILATION nùróddòyò

The following rule of centralization accounts for the neutralization of the feature [round] by indicating the changes in the articulation of both /i/ and /u/.

Rule 8. CENTRALIZATION

$$\left[\begin{array}{c} \text{V} \\ +\text{high} \\ -\text{long} \end{array} \right] \rightarrow \left[\begin{array}{c} +\text{back} \\ -\text{round} \end{array} \right] / \text{C} \text{---} \text{C}^{\$}$$

The rule states that short /i/ and /u/ will become [ɨ] when following a back consonant in closed syllable.

Underlying	/tékk- +tù/ rub Vent Imp	/tékk- +nà/ Vent Perf	/tékk- +kò/ Perf
C ASSIMILATION [Frajzyngier 1978]	tékk-llù	tékk-llà	---
STOP → CONTINUANT [Frajzyngier 1978]	---	---	tékk-lyò
R-18a VOWEL RAISING	tíkk-llù	---	---
R-3 EPENTHESIS II	tíkkúllù	tékkíllà	tékkúlyò
R-8 CENTRALIZATION	tíkkfllù	tékkfllà	tékkfilyò
	'rub and come'	'he rubbed and came'	'he rubbed'

Compare the above example with the Imperative form tékkúlò 'rub!'. A few more examples in which the same process takes place are:

yékl- mix	+ tù Vent	→ [yígfɪlù]	(following VOWEL RAISING, C VOICING, EPENTHESIS)
yékl- mix	+ nà Perf Vent	→ [yéyɪlà]	(following EPENTHESIS, STOP → CONTINUANT)
cúgd- comb	+ nà Perf Vent	→ [cúgfɪnà]	(following EPENTHESIS, C ASSIMILATION)

Compare the last example with the following with which it constitutes a near-minimal pair:

cúug- spread	+ nà Perf Vent	→ [cúugɪnà]
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The above examples have all involved centralization of *epenthetic* vowels. Though I have found no examples of centralization of *underlying* /u/, the following shows centralization of underlying /i/:

/gìnnímà/	→ [kɪnnímà]	'deity'
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The vowel *i* also undergoes centralization in another context which does not affect *u*. Therefore the following rule does not contribute to the neutralization of the feature round but rather assigns a redundant feature to the [-round] vowel *i*:

Rule 9. *i* CENTRALIZATION

$$\left[\begin{array}{c} V \\ +\text{high} \\ -\text{round} \end{array} \right] \rightarrow \left[\begin{array}{c} +\text{back} \\ -\text{round} \end{array} \right] / \left[\begin{array}{c} C \\ -\text{voice} \\ +\text{labial} \end{array} \right] C _$$

The rule states that /i/ will become [ɨ] when following a voiceless labial consonant in non-initial position. This last condition is indicated by postulating the left environment for the rule as CC, since this is the only non-initial environment in which a voiceless consonant may occur in Pero: Intervocalic single consonants are always voiced (cf. Frajzyngier [1978]).

nápp-c- touch P1	+ -jì Habit	→ [náppɸccì]	'they always touch'
ápp-c- open P1	+ -ánì Stat	→ [áppɸjáanì]	

In both of the above examples the rule of centralization was preceded by Rule 3, which inserts epenthetic [i] to break up a consonant cluster which is not allowed by the syllable structure constraints.

5. The Contrast Between Long and Short Vowels

There is no phonological contrast of length in word final position; I did not perceive any phonetic variations in length in this position either. In word initial position length is distinctive only for the low vowel /a/:

áǎú 'eat' áájò 'stop quarrel'

In word medial position a length contrast was recorded for all vowels:

búǎú	'mix (with oil, water, etc.)'	búúǎú	'leak'
cóǎú	'put'	cóúǎú	'rinse cloth'
píǎú	'buy'	bííǎú	'husk, peel'
tééǎú	'cross'	téíǎú	'ask'

This system of length distinctions is unusual in West Chadic. Schuh (to appear) claims that no contrast of length in mid vowels in word medial position can be reconstructed for West Chadic, but the examples quoted above are by no means exceptional, and the distinction is not only phonetic but phonemic as well. The height of the final vowel of the verbal forms above is determined by the weight of the first syllable in essentially the same way as described for Kanakuru in Frajzyngier [1976], i.e. the final vowel of the verb is [-high] if the first syllable is heavy but it is [+high] if the first syllable of the verb is light.

In certain contexts, such as formation of the imperative, the short mid vowels function as long regardless of their phonetic length, and they invariably require the final vowel to become [-high] as in the above examples *téíǎú* 'ask' and *cóúǎú* 'put'. There are, however, other contexts, such as formation of the plural verb, in which the length distinction in mid vowels is contrastive and determines the form of the plural stem.

A preliminary internal reconstruction of the vowel system indicates that long [ee] in medial position may be derived from long [ii] as one of its sources. In the nominal system of Pero there is no long [ii] save for borrowed words. Restricting the analysis to nouns would even argue against

the phonemic status of [ee] in Pero. However in the morphology of verbs there is a four way contrast between /i~/ii/ and /e~/ee/. The "suspicious" element in this contrast is /ii/ since it occurs much less frequently than the rest of the elements.

A long vowel is shortened when occurring in a closed syllable which has a non-sonorant final consonant. This is captured by the following rule:

Rule 10. VOWEL SHORTENING

$$V \rightarrow [-long] \left/ \begin{array}{l} \text{C} \\ \text{[-son]} \end{array} \right. \text{\$}$$

píit- tù → [píittù]
make fire Vent

Long vowels do occur, however, when followed by a sequence of consonants, the first of which is a sonorant:

píit- + na → [píinnà] 'made fire and came'
make Vent
fire Perf

káandè 'okra'

céerrò 'talk for me!' (cf. céerò 'talk!')

The syllable boundary in such words is after the vowel and before the first sonorant, i.e. *káa\$ndè*, *píi\$nnà*. This syllabic division was obtained in *lento* speech.

Although length in Pero is phonemic, not all phonetic long vowels derive from underlying long vowels. Most of these vowels will be discussed later in this paper in Section 8. Here I will only mention one possible source of such vowels, viz. consonant deletion in intervocalic position. The process can be illustrated with the verb *máalò* 'wander about'. Its plural form is *mákkúlò*. As other plural forms similar to this, it has been derived through reduplication of the medial consonant. One has therefore to assume that the underlying form of the verb to 'wander about' is not *máalò* but rather /*mákálò*/. When a stop occurs in intervocalic position it becomes a voiced continuant, according to a well attested rule in Pero (see Frajzyngier [1978]). We would have therefore a form *máyálò*. Since this form does not exist one has to assume that the intervocalic

voiced continuant was deleted. Such a rule for deletion is known in other West Chadic languages, e.g. in Kanakuru [Newman 1974:8], but it is not otherwise supported by the data in Pero, i.e. intervocalic continuants are normally not deleted.

Another possible source of long vowels is the deletion of glides in intervocalic position. This also will be dealt with later in this paper.

6. Vowel Lowering

There are several rules lowering vowels in Pero. Although the output of these rules is often similar, collapsing them together will not serve any purpose because the rule that would emerge would be so complicated that it would require a considerable effort on the part of the reader to break it down into several rules. The order in which the rules are written is arbitrary, with the rules having somewhat similar contexts being grouped together.

Rule 11. VOWEL LOWERING I

$$V \rightarrow [-\text{high}] / \left\{ \begin{array}{l} V \\ [+low] \quad \overline{[-\text{round}]} \\ \hline V \\ [+low] \end{array} \right\}$$

The rule states that /i/ will become [e] when preceded or followed by /a/ and /u/ will become [o] when followed by /a/. The following examples show various developments of this rule, first when the /a/ precedes the high vowel and then when it follows it.

/i/ → [e]

ta íp-ù → [téebù] 'he will catch'
Fut catch

Derivation of the phonetic form involves the following rules:

Underlying	/ta íp-ù/
R-11 VOWEL LOWERING I	ta épù
R-27 VOWEL ASSIMILATION	téepù
STOP VOICING	téebù (see Frajzyngier [1978])

à ímmíjè m → [àémfjèm] 'it is not that'
 Neg it is that Neg

Note that when /a/ precedes the lowering rule applies only to i, e.g.

à úmmò m → [àúmmòm] 'not this'
 Neg this Neg

Both /i/ and /u/ are lowered when *followed* by /a/, e.g.

ì ám → è ám 'it is water'
 Eq water

nì cáìù á → [nìjàlóá] 'may I walk around?'
 I wander around Q

cú + ánì → [cóánì] 'eating'
 eat Nom

It seems that the lowering of /i/ before [r] followed by [a] may be considered as part of the same rule. Compare the following examples:

cí + tá + wát- + tù → [šèràwátù] 'you (f) will come'
 2^f sg Fut come Vent

(/c/ → [š]/__[+voc][+voc], see Frajzyngier [1978])

cfn ní tá wát- tù -n- ì → [cínérátùnì]
 Rel I Fut come Vent 'Caus Rel
 Anaphora

'which shall I bring?'

The following rule is proposed to account for the lowering above:

Rule 12. VOWEL LOWERING II

$$\left[\begin{array}{c} V \\ -\text{round} \\ -\text{long} \end{array} \right] [-\text{high}] / _ \left[\begin{array}{c} +\text{voc} \\ -\text{cons} \end{array} \right] \left[\begin{array}{c} V \\ +\text{low} \end{array} \right]$$

Note that this rule differs from the preceding rule only in the fact that [r] precedes the low vowel, which must be considered the decisive factor in lowering.

Vowels in medial closed syllables are lowered one degree:³

³One would like a rule which more directly represents that vowels are lowered one degree. In an earlier draft of this paper I present the following form for Rule 13:

Rule 13. VOWEL LOWERING III

$$V \rightarrow \begin{bmatrix} \text{-high} \\ \text{<+low>} \end{bmatrix} / V(C(C))_CCV$$

Condition: Does not apply to /o/.

This rule lowers the high vowels to corresponding mid vowels and the mid vowel /e/ to [a]. The rule may be applied only once to a vowel to prevent /i/ → e → [a].

The following examples illustrate first the application to the non-round vowels and then to the round vowel.

/i/ → [e]

nì íll- + kò → [nìéllòyò] 'I stood up'
I stand up Perf

cì mà + yì + n + nò → [cìmàyénnò] 'if you (f) don't make for me'
2f Cond do Ben me

/e/ → [a]

àn + céngò → [ànjángò] 'one who is stubborn'
Sing stubborn

nì + ceyy- + ko → [nìjáyyóyò] 'I drank all of it'
I p drink Perf
Pl

It appears that the above rule can also operate across word boundaries. In this case it is dependent on the tempo of speech:

fójè + n dábà [fójàn dábà] 'Daba's chicken'
chicken Poss

tójè + n táyà [tójàn táyà] 'Taya's horse'
horse

To see that the decisive factor here is the presence of the next word, compare the following example in which the lowering does not take place:

à kéekè m → [àkéekèm]
Neg bicycle Neg

$$V \rightarrow \begin{bmatrix} \text{[a}_{\text{high-1}}] \\ \text{[a}_{\text{high}}] \end{bmatrix} / V(C(C))_CCV$$

A convention would then interpret resulting [+high-1] as [-high] and [-high-1] as [+low]. This type of formalism could easily be adapted to languages with more than three degrees of height.

/u/ → [o]

nì + mún- kò → [nìmóngò] 'I gave'
I give Perf

Cf. munnòwè 'give me (something)'

bálù + n + kà cákkà → [bálongà jákkà] 'tire him'
get tired Caus Cong 3 p sg m

The form àngóndòl recorded in Kraft (n.d.) must be derived from:

àn + kúndùl → [àngóndùl] 'native doctor'
Sing deity

The next two rules are similar in that the consonant following the lowered vowel is [+back]. The differences between these rules are however so numerous that they warrant postulation of two different rules.

Rule 14. VOWEL LOWERING IV

$$\begin{bmatrix} \text{v} \\ +\text{high} \\ -\text{long} \end{bmatrix} \rightarrow [-\text{high}] / \$(\text{C}) _ \begin{bmatrix} \text{C} \\ +\text{back} \\ +\text{cont} \end{bmatrix} \text{v}$$

The rule says that a high vowel will be lowered to the next vowel of the same class when preceded by a syllable and followed by the back fricative [ɣ].

The following examples illustrate first the application of the rule to /i/ and then to /u/:

/i/ → [e]

mà cǐyà → [màjéyà] 'you are a jackal'
you jackal

nì + yí + kò → [nìyéyò] 'I made'
I make Perf

Cf. yí + kò → [yíyò] 'he made'

mù + lí + kò + n → [mùlyéyòn] 'those who were appointed'
Rel put Perf Caus

Cf. lí + kò → [líyò] 'he put'

/u/ → [o]

à fúyà m → [àvóyàm] 'not a thigh'
Neg thigh Neg

à + júk + m → [àjjóyùm] 'not a chair'
Neg chair Neg

Derivation of the last form involves not only the lowering rule 14 but also the epenthesis rule 1, which produces àjjúkùm, and the stop → continuant rule [Frajzyngier 1978] which produces àjjúyùm. Lowering applies only after the stop → continuant rule.

Ample examples of the application of this rule may be found in the non-ventive perfective forms of the verbs which have the first syllable heavy, i.e. which require a vowel insertion before addition of the suffix -kò :

Underlying	ádd- + kò eat Pf	cóov- + kò rinse cloth Pl Pf	ícc- + kò grind Pl Pf
R-3 EPENTHESIS II	áddúkò	cóovúkò	íccúkò
STOP → CONTINUANT [Frajzyngier 1978]	áddúyò	cóovúyò	íccúyò
R-14 VOWEL LOWERING	áddóyò	cóovóyò	íccóyò
	'they ate'	'they rinsed cloth'	'they ground'

When the back consonant that follows the "vulnerable" vowel is a voiced stop, then the rule does not apply, e.g. kúbúgò 'he has tasted the liquid', rímbúgò 'he has made, produced something'. While the above may be sufficient as an explanation of the constraint on the application of the lowering rule 14, one has to explain why the velar consonant becomes a voiced stop rather than a fricative. The following rule, which is ordered after Rule 3 EPENTHESIS II, accounts for the voicing of the velar stop without fricativization:

Rule 15. VELAR STOP VOICING

$$C \rightarrow [+voice] / V \quad (C) \quad C \quad V$$

$$[+back] \quad \quad \quad [+high][+voice][+voice][+high]$$

The rule states that a velar consonant is voiced when it follows a high vowel preceded by a sequence consisting of a high vowel and a voiced consonant. The derivation of the examples quoted above and of other words meeting the condition of Rule 15 would have the following form:

Underlying	kúb- + kò	rímb- + kò	cúgd- + kò
R-5 EPENTHESIS III	kúbúkò	rímbúkò	cúgdúkò
R-15 VELAR STOP VOICING	kúbúgò	rímbúgò	cúgdúgò
			'he combed'

The following are further examples in which lowering predictably does not apply:

pínn-	kò	→	[pínníḡò]	'they washed'	
wash P1	Pf				
cì	dí-	kò	→	[cìdíḡò]	'who stayed'
Rel	stay	Pf			

The back consonant is a deciding factor in the next lowering rule, but the scope of the rule is much narrower and the conditions are different.

Rule 16. VOWEL LOWERING V

$$\left[\begin{array}{c} V \\ -\text{round} \\ +\text{high} \end{array} \right] \rightarrow [-\text{high}] / \#\# \left[\begin{array}{c} C \\ +\text{back} \\ -\text{cont} \end{array} \right] C$$

The rule states that /i/ will become [e] before /k/ or /g/ followed by another consonant when in word initial position.

The evidence for this rule consists of two observations. First, there are no lexical morphemes in Pero that have a high front vowel followed by a velar consonant in word initial position. The second observation is the behaviour of the morpheme i(C)-, used as a copula in existential sentences. This morpheme is realized as /i/ before the words beginning with a vowel and as iC before the words beginning with a consonant. C in this case represents the same consonant as the initial consonant of the word to which the morpheme is prefixed:

ì ám	→	[èám]	'it is water'
water			
ì wóri	→	[ìwwóri]	'it is Wori'
n. p. f.			
ì cínù	→	[ìccínù]	'it is they'
they			

When this prefix is added to morphemes with an initial back consonant the vowel is lowered:

ì ká jégèr loc morning	→ [èkká jégèr]	'it is in the morning'
ì gbáy dog	→ [ègbáy]	'it is a dog'
ì kpáttìn man	→ [èkpáttìn]	'it is a man'
ì kpéemùn woman	→ [èkpéemùn]	'it is a woman'

In the last three examples, the initial consonant, if reduplicated, is subsequently deleted, because three consonant clusters are not allowed in Pero (see Frajzyngier [1978] for derivation of [kp] and [gb]).

The last rule of lowering applies to the non-back high vowel /i/. It cannot be ascertained that it would not apply to the high back vowel if there were in Pero suffixes with initial /u/. Since no such suffixes were recorded the rule will be formalized to apply only to /i/.

Rule 17. VOWEL LOWERING VI

$$\left[\begin{array}{c} V \\ +\text{high} \\ -\text{round} \end{array} \right] \rightarrow [-\text{high}] / \left[\begin{array}{c} V \\ -\text{high} \\ +\text{round} \end{array} \right] _##$$

The examples chosen are of the nouns ending in /o/ plus the definite suffix:

ló meat animal	+ ì def	→ [lòè]	'the meat/animal'
fúró tree	+ ì def	→ [fúròè]	'the tree'
dúò bird	+ ì def	→ [dúòè] ^{R-26} → [dúè]	'the bird'

Cf. bwé + ì → [bwéì] 'the gruel'
gruel def

Notice that the above rule is similar to the upper part of Rule 11, lowering the vowel after /a/. One could collapse these rules together but the new rule would require the introduction of the feature [back]. Differences in the behaviour of the vowels still remain as the high round vowel is not lowered after [o]. Since even the collapsed rule would have two different expansions the two rules may remain separated as proposed in this paper.

7. Raising

The contrast high vs. non-high in Pero is also neutralized by the following raising rules.

Rule 18a. VOWEL RAISING I

$$\begin{array}{c}
 \text{V} \\
 [-\text{low}]
 \end{array}
 \rightarrow [+high] / (__ \text{C}) __ (\text{C})\text{C} + \text{C} \quad \text{V} \quad \begin{array}{c} \\ [+high] \end{array}$$

The rule states that one or more non-low vowels (i.e. non /a/) are raised when a suffix consisting of consonant and a high vowel is added to a form ending in a consonant. The rule is well motivated as the deciding factor here is the height of the vowel in the suffix. The following are examples of the application of this rule:

/e/ → [i]

pér- -tù → [pɪrɪù] 'announce and come'
 announce Vent

pén- -tù → [pɪndù] 'know and come'
 know Vent

pén- -jì → [pɪnɪjì] 'always know'
 know Hab

dét- -tù → [dɛttù] 'get and come'
 get Vent

bél- -tù → [bɛllù] 'break and come'
 break Vent

bèbùl- -tù → [bɛ̀bùllù] 'break many and come'
 break pl Vent

/o/ → [u]

wócc- -jì → [wúcɔ́jì] 'always leave' (R-3 EPENTHESIS II follows
 leave Hab R-18a)

tónd- -jì → [túndɔ́jì] 'always sew'
 sew Hab

fócc- -tù → [fúttù] 'pray and come'
 pray

cókòt- -tù → [cúkɔ́ttù] 'lift and come' (R-8 CENTRALIZATION fol-
 lift lows R-18a)

To the above rule there is only one lexical exception in Pero, viz. the verb kóv- 'to forge', e.g.

kóv- -jì → [kóvǐjì]

rather than the expected [kúbǐjì]. I do not think that this exception undermines the rule since this verb is exceptional in many other respects, e.g. its imperative form is kóvù rather than the expected kóvò. Its plural formation also differs from what one expects from the verbs having the phonological characteristics of kóvù (cf. Frajzyngier [1977]).

Another closely related rule which accounts for raising is much more limited in scope as it applies to monosyllabic verbs only. Monosyllabic verbs in Pero retain the final vowel when a suffix is added. This vowel is raised if the suffix consists of a consonant followed by a high vowel. The following rule is the formalization of the above statement:

Rule 18b. VOWEL RAISING II

$$V \begin{matrix} \rightarrow [+high] / \\ [-low] \end{matrix} \quad \begin{matrix} \# \# C \\ [VERB] \end{matrix} + C \quad V \begin{matrix} \\ [+high] \end{matrix}$$

wé see	-tù Vent	→ [wírù]	'see and come'
jé drink	-jì Hab	→ [jǐjì]	'always drink'
lé give birth	-tù Vent	→ [lírù]	'give birth and come'
ké chop	-tù Vent	→ [kírù]	'chop and come'

but compare:

cá descend	-tù	→ [cáarù]	'come down'
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(At present I am unable to account for the length of the vowel in the last two examples.)

Raising sporadically occurs across word boundary when a monosyllabic verb is followed by another word containing a high vowel, e.g.

có drink (Imp)	-mín beer	→ [cùmín]	'drink beer!'
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Outside of the verb system Rule 19 has been found to operate only with the noun *we* 'thing' when it is followed by possessive pronouns:

wíjì 'yours (f. sg.)' ("your thing")
 wímù 'ours' ("our thing")

but

wénò 'mine' ("my thing")
 wéyò 'yours (m. sg.)' ("your thing")

The reason why raising occurs in the above construction and not in others is probably because the construction with *we* has been grammaticalized as a marker of the independent possessive pronoun.

A final raising rule is the following:

Rule 19. /e/ Raising

$$\begin{bmatrix} V \\ -\text{high} \\ -\text{round} \\ -\text{low} \end{bmatrix} \rightarrow [+high] / C \begin{bmatrix} \text{VERBAL} \end{bmatrix} C + \begin{bmatrix} V \\ +\text{high} \\ -\text{round} \end{bmatrix}$$

The rule states that /e/ will become [i] when in the verbal root to which a high vowel suffix is added. Note that unlike the raising rules 18a and 18b, this rule does not apply to the mid back vowel /o/. Compare the following examples:

pét- -i → [pírì] 'he should go out'
 go out Subj
 kém -i → [kímì] 'he should fill'
 fill Subj
 cék- -i → [cígì] 'he should be lost'
 be lost Subj

but

tók- -i → [tóyì] 'he should kill'
 kill Subj

8. Contact Between Vowels and Operations on Glides

8.1 Introduction. Unlike the previous sections of this paper which began with a certain rule and then proceeded to the environments in which the rule operates, the present section describes the environment consisting of two adjacent vowels and then proceeds to describe various rules that operate in

this environment. This departure from the model of description used above is justified by the fact that the environment is the same in terms of the major classes involved in it, while the rules that operate here supplement each other. It is also assumed that this manner of description will be more appropriate from the point of view of the reader, who is more likely to ask "what happens when two or more vowels are in contact" rather than to ask about a rule whose existence cannot even be predicted. The description that follows will not repeat the instances of lowering rules described earlier in the paper.

There are two sources from which adjacent vowels may emerge. One is the underlying structure within one morpheme or in two consecutive morphemes. The other source is the glide deletion rules operating across morpheme boundaries. One might even claim that in certain instances there is a glide deletion rule operating within the morpheme. This distinction is necessary because of the rules related to glide insertion; the latter will not apply to the vowels that come into contact as a result of the glide deletion rules. In order to assure that such vowels will not be considered in the glide insertion rules the glide deletion is presented first. This will be followed by glide insertion rules and then by vowel deletion rules.

8.2. Glide Deletion

Rule 20. /y/ Deletion

$$\begin{array}{c} /G/ \\ [-back] \end{array} \rightarrow \emptyset / \left[\begin{array}{c} V \\ -round \\ -high \end{array} \right] _ + \begin{array}{c} V \\ [-round] \end{array}$$

The rule states that [y] will be deleted when preceded and followed by non-round vowels. Note that the rule applies only to the underlying glides and not to the phonetic glides, to be described later in the paper.

$$\begin{array}{l} ká + yèbí \\ at \quad \quad \quad back \end{array} \rightarrow [káèbí] \quad \text{'after'}$$

$$\begin{array}{l} à \quad yí \quad -jì \\ Neg \quad work \quad Prog \end{array} \rightarrow [éejì] \quad \text{'he is not working'}$$

Derivation of the phonetic form [éejì] involves the following ordered rules:

Underlying	a	yí	jì
R-20 GLIDE DELETION	à	í	jì
R-11 VOWEL LOWERING I	à	é	jì
R-27 VOWEL ASSIMILATION	[ééjì]		

In addition to the above rules there is a tone change linked with the vowel assimilation.

mà	+ yé	+ nà	→ [màéénà]	'when (they) call'			
Temp	call	Perf					
cí	+ yé	+ nà	+ ée	+ nò	+ n	→ [cfènéénòn]	'[by] which I was called'
Rel	call	Perf	Pre- Pro	1 sg	Caus		

Note that the tone of the perfective suffix *nà* has been shifted onto the verb root.

élé	+ yándò	→ [élé ándò]	'the sound of exclamation'
sound	happy or sad exclamation		

If the initial vowel is high, i.e. /i/ the rule doesn't apply.

nì	+ yé	+ nà	→ [nìyéénà]	'I called (here)'
1 sg	call	Perf Vent		
nì	+ yí	+ nà	→ [nìyínà]	'I did and came'
	do			
nì	+ yí	+ jì	→ [nìyíjì]	'I do'
		Hab		

I have recorded a few instances when the rule does not apply despite the fact that the environment is met. It is likely that the main reason for non-application of the rule is a slower than normal tempo of speech. The instances of non-application of the rule occur in elicited sentences rather than in the collected texts. One such example is the following:

tà	+ yíw-	áanì	→ [tàyíwáanì]	'he will know'
Fut	know	Stat		

The back glide /w/ is deleted only between low vowels. The following rule accounts for this deletion, but just as was the case with the deletion of the palatal glide, there are instances when the rule was found not to apply. Again, the only explanation that I can offer for this is speech

tempo.

Rule 21. /w/ DELETION

$$\begin{array}{c} G \\ [+back] \end{array} \rightarrow \emptyset / \begin{array}{c} V \quad V \\ [+low] \quad [+low] \end{array}$$

tà + wát- tù + á → [tátòá] 'will he come?'
Fut come Vent Q

(Note lowering of the high vowel of the ventive suffix before /a/ by Rule 11.) Vowel shortening follows the glide deletion.

The instances of back glide deletion are equaled in number by instances in which it is not deleted; therefore, the status of the rule governing it remains questionable. The following is one of the counter-examples to this rule:

nì + á + wá + m → [náawàm] 'I don't see'
1 sg Neg see Neg

8.3. Glide Insertion and Glide Formation Rules. There are two processes by which a glide that is not part of underlying structure may appear in the phonetic structure of Pero. One is the process in which a glide is inserted between two vowels without any changes in the syllabic structure of the utterance; the other is the process in which a high vowel becomes a glide and the syllabic structure of the utterance is changed.

These processes are similar in both their outputs and the environments. The differences however are numerous enough to require the postulation of two different rules to account for the phenomena.

Rule 22. GLIDE INSERTION

$$\emptyset \rightarrow \begin{array}{c} G \\ [around] \end{array} / + (C) \begin{array}{c} V \\ [around] \end{array} \text{---} [LEXICAL] +V$$

The rule states that a glide is inserted between a monosyllabic lexical morpheme ending in a vowel and the next morpheme beginning with a vowel. The value of the feature [round] of the glide depends on the preceding vowel.

tà wà ée mà → [tàwàéemà] 'he/she will see you'
Fut see Pre- 2 pl
Pro

dí áni → [dìyáani] 'settling'
 settle Nom

Postulating the above rule of glide insertion may help in explaining the formation of the plural form for monosyllabic verbs. There are several processes by which the plural form of the verb is derived in Pero, and all of them depend on the phonological structure of the verb (cf. Frajzyngier [1977]). Monosyllabic verbs differ from all other verbs by the absence of syllable reduplication or consonant gemination. Instead, in monosyllabic verbs another syllable is created by addition of a vowel. One can formalize this process by the following rule:

Rule 23. MONOSYLLABIC PLURAL STEM PREPARATION

$$\begin{array}{ccc} \text{CV} & \rightarrow & \text{CV V} \\ \text{[VERB]} & & \text{[PLURAL]} \end{array}$$

Addition of another syllable consisting of a vowel creates an environment for a non-round glide insertion as all the verbs have a final non-round vowel in the base from which plural stems are formed, viz. pre-perfective forms.

After the palatal glide is inserted it is reduplicated, i.e. it is treated as if it were an underlying consonant. Reduplication in turn creates a heavy first syllable which determines the height of the final vowel of the verb (cf. Frajzyngier [1976]). The examples illustrating formation of the plural form will derive the imperative form of the verb, which requires a round vowel:

	cá	cé	cé	ké
	descend	drink	eat	cut
R-23 MONO PLURAL PREP	cá-V	cé-V	cí-V	ké-V
R-22 GLIDE INSERTION	cáy-V	céy-V	cíy-V	kéy-V
R-4 PLURAL V FORMATION	cáyy-V	céyy-V	cíyy-V	kéyy-V
IMPERATIVE	cáyyò	céyyò	cíyyò	kéyyò

Following are some of the examples of the insertion of the round glide inserted by Rule 22:

cú eat	-ì Inf		R-22 →	[cúwì]	'to eat'	
có drink	-ì Inf	R-17 →	có è	R-22 →	[cówè]	'to drink'
yú work	-áanì Stat	R-11 →	yò áanì	R-22 →	[yòwáanì]	'worked'

The other rule that accounts for the presence of glides in the surface structure is the rule of glide formation.

Rule 24. GLIDE FORMATION

$$\left[\begin{array}{c} V \\ +\text{high} \\ \text{around} \end{array} \right] \rightarrow \left[\begin{array}{c} G \\ \text{around} \end{array} \right] / C _ +V$$

This rule states that a high vowel will become a glide when followed by another vowel across a morpheme boundary.

cú + áanì eat Stat	→	[cwáanì] ⁴	'eaten'
pàenátù + ì monster Def	→	[pàenátwì] (one /t/ is deleted)	'the monster'
à + lí + ée + nò Neg put Pre- l s	→	pídà + m wound Neg	[àlyéenò bídàm] 'it doesn't hurt me'
		pron Ben	

The above rule operates across word boundaries as well, e.g.

mù + n + té + wé + tù Opt Conj Fut see Vént	→	íì land	[múndìwérwíì]
			'let them see the land'

There are a number of phonological rules operating on the above representation. The vowel which becomes a glide is underlined.

mátù + mù + ránà + m car this Neg fast Neg	→	[mátù <u>m</u> wáranàm]	'this car is not fast'
---	---	-------------------------	------------------------

There is evidence that this rule operates or used to operate in morpheme internal position as well, at least for the high round vowel.

There is a group of words (described in Frajzyngier [1978]) that have an

⁴Factors governing the choice of Rule 24 here rather than Rule 23, as in the case of cúwì 'to eat' above, are unknown.

initial labiovelar stop, [kp] or [gb]. When this stop occurs in intervocalic position, e.g. in the negative frame, instead of the stops we have a cluster consisting of stop and a glide, i.e. [kw] or [gw]. Since there are no morpheme internal sequences of [u] plus another vowel it is postulated that in Pero the following process takes place:

$$C_1 \quad V \quad V \rightarrow C_1 w V \rightarrow C_1 \quad C_2 \quad V \\ [+back] [+round] \quad \quad \quad [+stop]$$

Very often the output of the above process is phonetically realized as C₂V, as the result of the deletion of C₁, e.g.

$$/kúàttìn/ \rightarrow kwàttìn \rightarrow [kpáttìn] \rightarrow [páttìn] \quad \text{'man'}$$

The last two forms were both recorded. The evidence for the second form is provided by such forms as [màywáttìn] 'you men'. Also there are no initial consonant clusters consisting of a velar consonant and a glide in Pero.

8.4. Vowel Deletion.

8.4.1. Morpheme Internal Position. A vowel may be optionally deleted in normal or fast speech when preceded or followed by a sonorant, i.e. by r, l, and nasal consonants. The following is the rule proposed to account for the deletion:

Rule 25. VOWEL DELETION I (optional)

$$V \quad \rightarrow \emptyset / \quad C \\ [-long] \quad \quad \quad [+son]$$

píit- + kò → [pírgò]
make fire Perf

The following is the derivation of this form:

Underlying	píit- kò
R-5 EPENTHESIS III	píitúkò
STOP → CONTINUANT [Frajzyngier 1978]	píirúkò
R-15 STOP VOICING	píirúgò
R-25 VOWEL DELETION I	píirgò
R-10 VOWEL SHORTENING	[pírgò]

Further application of this rule is blocked by syllable structure constraints. The ordering of the second and third rules is arbitrary and may be reversed.

The following verbs, although disyllabic in their quotation form, may be analyzed as deriving from the underlying trisyllabic forms by the following process:

Underlying	úgútò	lígúnò
	uproot!	answer!
STOP → CONT	úgúrò	-----
R-25 VOWEL DELETION I	[úgrò]	[lígònò]

For the verb 'to answer' a form with undeleted vowel lígúnò has been recorded as well. The vowel which has been deleted from the imperative form is retained in other forms where its deletion would violate a syllable structure constraint, e.g.

lígún- + tù → lígúndù ^{R-8} [lígʌndù] 'he answered and came'
 answer Vent

(See Frajzyngier [1978] for voicing of stop.)

Additional evidence for the correctness of the above analysis is provided by the following discussion. Let us assume that the underlying structure of the verb [úgrò] is /úgt-/ , i.e. let us assume that it does not have a medial vowel. A morpheme structure constraint which does not allow a sequence of consonants with different values for the feature [voice] will force one of the two phonetic realizations for the above underlying form: [úkt-] or [úgd-]. Were such forms not allowed in the phonetic structure of Pero, the vowel insertion rule would require insertion of a high vowel between the consonants forming the cluster. But such clusters do exist in the phonetic structure of Pero (cf. [cúgdò] 'comb', [cúktù] 'lift it (Vent)'). The following derivation provides additional evidence for the underlying medial vowel:

úgút + kò → [úgúrgò]⁵ 'he uprooted'
 uproot Perf

The derivation of this form involves the following rules:

⁵Rule 25 could also produce the incorrect *[ugrugo]. I do not have an explanation now for the prediction of which vowel will be reduced.

	Underlying	ugut- ko
R-5	EPENTHESIS III	úgútúkò
R-15	STOP VOICING	úgútúgò
	STOP → CONTINUANT	úgúrúgò
	[Frajzyngier 1978]	
R-25	VOWEL DELETION I	[úgúrǵò]

The following is an example of vowel deletion before [y]:

fúyì + kò → [fy'ǵò] 'he ate it up'
eat up Perf

Note the deletion of [u] must occur before the suffix is attached because disyllabic verbs with the first syllable light delete the final vowel before suffixation. Were the suffixation in this verb to occur before the vowel deletion we would get the form *[fúyyò].

8.4.2. Morpheme final position. When a morpheme with a final vowel with a low tone is followed by another morpheme beginning with a vowel, the final vowel is deleted along with its tone. This rule has a constraint, viz. it does not apply to monosyllabic lexical morphemes, which always preserve their final vowel. The following is proposed as a formalization for the rule:

Rule 26. VOWEL DELETION II

$$V \rightarrow \emptyset / \frac{\quad}{[-\text{long}]} + V$$

[Low tone]

Condition: The rule does not apply to monosyllabic lexical morphemes.

Examples (the underlined vowels are deleted):

péemùn wórì á → [péemùn wórá] 'is the woman of marriageable age
woman Wori Q Wori?'

cf. wórì péemùn + á → [wórì péemúná] 'is Wori of marriageable
age?'

nì + úgút- + kò → [nùgúrǵò] 'I uprooted'
uproot

nì + á + wá + m → [návám] 'I don't see'
Neg see Neg

cì + ámbù- + kò + á → [šámbùyá] 'did you go?'

2^{-f} go Perf Q

Note that in the last example the deletion rule applies twice, to the subject pronoun cì and to the perfective suffix kò, in both cases deleting the morpheme final vowel.

pét- + tù + -ée- + kò → [pítteégò] 'he left and came'

leave V_{ent} Pre-pron 2_m ICP

péng- + tù + -ée- + kò → [píngíréégò] 'he retreated here'

retreat V_{ent} Pre-pron 2_m ICP

The above phonetic forms are derived through the application of the following ordered rules:

	Underlying	pét- tù + kò	péng- tù + kò
R-18a	RAISING	pítúkò	píngr tù kò
	CONS ASSIM [Frajzyngier 1978]	-----	píngrru kò
R-15	STOP VOICING	pítùgò	píngrrùgò
	SON DELETION [Frajzyngier 1978]	-----	píngrùgò
	-ée- INSERTION	pítùéégò	píngnúéégò
R-26	VOWEL DELETION II	pítteégò	píngréégò
R-3	EPENTHESIS II	-----	píngíréégò

The above deletion rule may be alternatively stated as involving a stem preparation rule, which would delete the final vowel before a morpheme beginning with a vowel is added. There is, however, good evidence that the vowel is deleted *after* another vowel is added. This evidence is provided by the following forms, all of which involve the definite suffix, realized /ì/ after vowels:

bwé + ì → [bwéì] 'the gruel'

gruel

júra + ì → [júré] 'the peanuts'

peanuts

róccò + ì → [róccè] 'the liver'

liver

The only way in which one can explain the final [ɐ] in the last two examples is by postulating that a lowering rule has applied to /i/. Such rules, in fact, have been postulated earlier in this paper for other contexts. The derivation of the last two examples would involve the following ordered rules:

	Underlying	júra + ì	róccò + ì
R-11	LOWERING	júraè	róccòè
R-26	VOWEL DELETION	jùrè	róccè

The best explanation that I can offer for the non-application of this rule to the monosyllabic lexical morphemes is that if the rule were to apply and the vowel were deleted the identification of the morpheme would become very difficult. When deletion would be expected for these roots, glide insertion (Rule 22) occurs instead.

8.4.3. Vowel deletion in sandhi. The primary factor affecting the deletion of vowels in sandhi is the tempo of speech. In normal and fast speech the final vowel may be deleted when followed by a word beginning with a vowel. At the same time, other phonological rules, such as lowering, may apply:

cékò + ám	→ [céyàm]	'drink water!'
drink water		
díkò + n + mù + ám	→ [díyònmwám]	'fetch us some water'
fetch Ben 1 pl water		
mù cínù wát- tù	→ [mùjínáttù]	'they should come, let them come'
Opt 3 pl come Vent		

Note that in the last example the glide deletion rule applies before the vowel deletion rule.

8.4.4. Three vowel sequence reduction. There is in Pero a constraint, similar to the constraint in Kanakuru (cf. Newman [1974]) which does not allow for the sequence of three adjacent vowels in the phonetic structure. When such a structure would emerge as a result of a morphological process one vowel is deleted:

dúò + ì	→ [dúè]	'the bird'
bird Def		

There are not enough examples to categorically state that it will be always the penultimate vowel that is deleted.

8.5. Vowel assimilation. While many of the rules described previously could be considered as instances of assimilation, in the present section only complete assimilation will be described. Morphologically instances of complete assimilation are restricted to the vowels of prefixes, e.g. subject pronouns, tense markers and relative markers. Phonologically only the vowels which are [-round] undergo complete assimilation. Moreover, in the examples that follow there will be no instances of /e/ assimilating to the following vowel because there are no prefixes with underlying /e/. Because of this fact I believe there is no need to specify in the rule that it applies to /i/ and /a/ but not /e/. The rule has to be specified as optional since in deliberate speech the assimilation does not take place.

Rule 27. VOWEL ASSIMILATION (optional)

$$\left[\begin{array}{c} V \\ -\text{round} \\ -\text{long} \end{array} \right] \rightarrow \left[\begin{array}{c} \text{around} \\ \beta\text{high} \end{array} \right] / \text{---} + \left[\begin{array}{c} V \\ \text{around} \\ \beta\text{high} \end{array} \right]$$

Examples:

nì + à + wá + m I Neg see Neg	→ [náawàm]	'I don't see'
cì + ámb- + kò + á 2 f climb Perf Q	→ [šáambúyà]	'did you climb?'
nì + úgút- + nà I uproot Perf Vent	→ [núugúnnà]	'I uprooted'
nì + ópp- + nà I dig Perf Vent	→ [nòoffúnà]	'I dug [it] there'
tà + ívù Fut catch	→ [téébù]	'will catch'

(Vowel Lowering applies before Assimilation)

nì + tà + ópp- + tù + ée + tò I Fut dig Vent Pre- 3 f pron	→ [ndóoppʃréerò]	'I will dig [it] for her'
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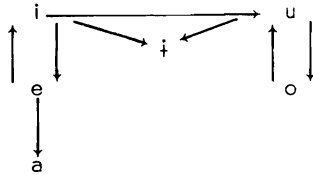
Compare, however, the following example in which the rule does not apply:

[j'ínní ékkò] 'which I caught'

9. Conclusions

The vowel system in Pero may be described in terms of the features [long], [high], [low], and [round]. Each of the features divides the system into two natural classes which behave similarly in their relationship with other vowels and with consonants. Thus, the vowels which are [+high, +long] affect the rule of voicing of stops; the choice between [p] and [f] as the realization of /p/ depends on the feature [round] of the following vowel.

The main characteristic of this system is the extensive neutralization which affects all of the distinctive features and all the vowels. The feature [long] is neutralized in closed syllables. The neutralization of the remaining features can be represented by the following diagram in which the arrows indicate the direction of change which produces the neutralization.



An interesting fact about the neutralization processes in the vowel system is the different resistance to change of the distinctive features or of the clusters of features. Thus /i/ becomes /u/ in certain environments but /u/ does not become [i]; at most it is centralized. Both mid vowels are subject to raising rules but only /e/ is subject to a lowering rule. The most stable vowel in Pero is /a/, i.e. the only underlying vowel with the feature [+low], which is not subject to any change other than that in 8.5 leading to the neutralization of distinctive features.

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