

Unmotivated Processes: The Case of Patep*

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1. Introduction

Patep phonology¹ has been analyzed by Adams and Lauck (1975) by looking for contrasts between phonetic segments and setting up as phonemes those which are contrastive. That procedure results in the contrastive phonemes shown in Chart 1.

CHART 1: CONTRASTIVE PHONEMES

| | | | | | | |
|----------------|-----------------------------|-----------------------------|----------------|-----------------------------|----------------|-----------------------------|
| p | p ⁱ | p ^w | t | t ⁱ | k | k ^w |
| ^m b | ^m b ⁱ | ^m b ^w | ⁿ d | ⁿ d ⁱ | ^ŋ g | ^ŋ g ^w |
| | | | s | | | h |
| β | β ⁱ | | ⁿ z | j | ɣ | w |
| | | | l | | | |
| m | m ⁱ | m ^w | n | n ⁱ | ŋ | ŋ ^w |
| | i | | u | | | |
| | e | | o | | | |
| | ɛ | a | ɔ | | | |

This analysis results in a fairly symmetrical phonemic inventory. However, the limited distribution of many of these putative phonemes raises doubts regarding their phonemic status. For example, consider the following distributional constraints.

- 1) Labialized and palatalized consonants are limited to the onset of stressed syllables.
- 2) The segments [h], [w], [j], [s], and [z] do not occur morpheme finally.
- 3) [ɛ] occurs only between consonants in word initial unstressed syllables. No other vowel occurs in that position.
- 4) The only vowel generally allowed in a syllable following the stressed syllable is [a]. The only exceptions to this occur when the vowel is identical with a preceding vowel separated by [h]; e.g. [líhi] 'leaf', [kéhe] 'base', and [júhu] 'sixth born child'.

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¹ Patep is an Austronesian language of the Buang language family in the Morobe Province of Papua New Guinea. It is one of five dialects in the Mumeng dialect chain and is spoken by approximately 1600 speakers. This paper is based upon data collected during residence in a Patep village intermittently since November, 1972, under the auspices of the Summer Institute of Linguistics.

- 5) The coda of final unstressed syllables can only be [ʔ].
- 6) Lengthened vowels occur only in stressed open syllables which are morpheme final. They contrast with short vowels in that position.
- 7) There are further constraints on the occurrence of vowels following labialized and palatalized consonants, viz.:
 labialized labials are followed only by [ə] or [o];
 labialized velars are followed only by [a], [i], [e], [ɛ];
 palatalized labials are followed only by [a], [e], [ɛ];
 palatalized alveolars are followed by any vowel.
- 8) Stress always occurs on the first full vowel in the word, i.e. either on the first syllable (when the vowel is not [ə]) or on the second syllable (when [ə] occurs in the first syllable).

These constraints result in a preferred canonical shape of morphemes which can be displayed as follows:

$$(C_1\text{ə}) (C_2) \acute{V} (C_3) (a(?))$$

except where C_3 is [h], in which case the canonical shape may also be:

$$(C_1\text{ə}) C_2 \acute{V}_1 h V_1$$

In other words, a morpheme in Patep consists of up to three syllables. The stressed syllable is optionally preceded by an unstressed syllable containing [ə] as the vowel, and is optionally followed by an unstressed syllable with [a] as the vowel and [ʔ] as the only consonant which can close that syllable. Any consonant may occur as C_2 . A more limited set occurs as C_3 ; those which do not occur are labialized and palatalized consonants, [s], [z], [w] and [j]. The set of consonants which may occur in the C_1 position is even more restricted than those occurring in C_3 . Only the segments [p], [t], [k], [β], [l], [ŋ] and [h] occur with any frequency; [b], [d], [g], [m], [n], and [s] occur only rarely.

It seems that there should be some phonological explanation for at least some of these distributional constraints. In particular, the restriction of labialization to velar consonants followed by nonround vowels and to labial consonants followed by round vowels, and the restriction of palatalization to coronal consonants and to labial consonants followed by nonround vowels seems more than coincidental. In this paper I attempt to explain some of these restrictions within a generative framework.

Various phonological rules, some requiring abstract underlying segments are discussed. These result in a symmetrical underlying sound inventory with fewer phonemes. Throughout the discussion, however, it becomes clear that it is difficult to find evidence to show that the proposed rules are well motivated and not just ad hoc ones contrived in order to come up with an elegant solution, since there are very few morphemes in Patep with

phonological alternations to serve as internal evidence for these proposed underlying forms and phonological rules.

Loan phonology and evidence from related dialects and languages in the Buang language family give motivation for some of the posited rules. However, in many cases it seems that there is no clear basis upon which to decide whether the gaps in the distribution of segments represent surface structure constraints, morpheme structure constraints, or systematic regularities which can be expressed by phonological rules.

The remainder of the paper will be a discussion of each of the areas in Patep phonology which are related to surface distributional constraints in the segments. The constraints will be discussed in more detail and then possible analyses given, along with supporting and/or counter evidence for the various possible analyses. Since most of these areas are interrelated, I will also mention how particular hypotheses affect the analysis in other areas of the language. I will conclude by combining the various preferred hypotheses into one possible system of underlying representations, morpheme structure constraints (MSCs), and phonological rules. Some sample derivations will be included. An alternative analysis will also be briefly outlined.

2. Schwa and Stress

In Patep morphemes, schwa occurs only in initial unstressed syllables between consonants. It is the only vowel to occur in that position. Two possible analyses are Schwa Epenthesis, or Pre-tonic Vowel Neutralization.

Schwa Epenthesis (ə-Epen)

$$\emptyset \rightarrow \begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{low} \\ +\text{back} \\ -\text{round} \end{bmatrix} / \# \text{ C } __ \text{ C}$$

(Schwa is inserted between two consonants at the beginning of a word.)

Pre-tonic Vowel Neutralization (PreVN)

$$[+\text{syll}] \rightarrow \begin{bmatrix} -\text{high} \\ -\text{low} \\ +\text{back} \\ -\text{round} \end{bmatrix} / __ \text{ C } \begin{bmatrix} +\text{syll} \\ +\text{stress} \end{bmatrix}$$

(All vowels are neutralized to [ə] in initial unstressed syllables.)

There are two factors which suggest schwa epenthesis. One is that schwa epenthesis is a process which occurs in other places in the language. When compounding results in consonant clusters, an epenthetic schwa separates the consonants. The same is true for many combinations of consonants which come together across full word boundaries. Therefore, schwa epenthesis is an established process in the language. It should be noted, however, that the rule for schwa epenthesis across internal and full word boundaries applies to a limited set of the consonants, whereas it would apply to all consonant clusters within words.

Another factor supporting the schwa epenthesis hypothesis is that it facilitates the placement of stress. Stress can be assigned to the first vowel of the word and then an epenthetic schwa be inserted between two initial consonants. One disadvantage of this analysis is that it forces one to posit underlying consonant clusters at the beginning of words, even though consonant clusters are not a feature of the language.

In support of pre-tonic vowel neutralization is the fact that vowel neutralization also is a process which seems to be at work in Patep words. Within morphemes, whenever there is a syllable following the stressed syllable, the vowel in that syllable is almost always [a].² A rule of Post-tonic Vowel Neutralization can be formulated to express this process.

Post-tonic Vowel Neutralization (PostVN)

$$[+syll] \rightarrow \left[\begin{array}{c} +low \\ +back \\ -round \end{array} \right] / \left[\begin{array}{c} +syll \\ +stress \end{array} \right] (C) \text{ ___}$$

(All vowels are neutralized to [a] in an unstressed syllable following a stressed syllable.)

The major exception to this rule is when (C) is [h], in which case the adjacent vowels are usually identical and may be any vowel, i.e. V_1hV_2 . However, the analysis of [h] involves other considerations and will be discussed separately.

Therefore, both processes (schwa epenthesis and vowel neutralization) appear to be processes which occur in Patep. Also, both processes are used in assimilating loan words into Patep.

Schwa insertion

| Tok Pisin | Patep | |
|-------------|----------------------|----------|
| <i>blu</i> | [^m bəlu] | 'blue' |
| <i>skul</i> | [səkul] | 'school' |
| <i>plet</i> | [pələt] | 'plate' |

² Most of the apparent exceptions to this rule can be explained. Some are loan words, e.g. Tok Pisin [sako] 'chayote', [pato] 'duck'. Some are likely compounds, e.g. [tatóβ] 'source', from [ta] 'mother/intensifier' and [toβ] 'long'; [k'ábó] 'close' from [k'a] 'neck' and [bo] 'short'. A few forms remain unexplained, e.g. [susu] 'things' (possibly a reduplication of [su] 'put') and [mégem] 'therefore' (possibly derived from [mége] 'certainly' and [ɔm] 'therefore').

| | | |
|----------------|------------|------------|
| <i>spun</i> | [səpún] | ‘spoon’ |
| <i>trausis</i> | [təláusas] | ‘trousers’ |

Vowel neutralization to schwa

| | | |
|--------------------|-----------------------|----------------|
| Tok Pisin | Patep | |
| <i>gálip</i> | [^g gəlíp] | ‘peanut’ |
| <i>kápa</i> | [kəpá] | ‘roofing iron’ |
| Jabêm ³ | Patep | |
| <i>kêlêpê</i> | [kəlípí] | ‘pencil’ |
| <i>padi</i> | [pə ⁿ dí] | ‘rice’ |
| <i>kapiŋ</i> | [kəpíŋ] | ‘scissors’ |
| <i>kabaŋ</i> | [kə ^m bán] | ‘lime’ |
| <i>bêlêm</i> | [^m bəlém] | ‘nail’ |

A strong factor in favor of pre-tonic vowel neutralization is that some related dialects in the Mumeng dialect chain have a full vowel in the position where Patep has schwa. For example, ‘ground’ in Patep is [kə^mbún], but in other dialects is [ke^mbún], [kə^mbún], [ku^mbún], or [ké^mbun]. The morpheme ‘nose’ [nəlú] has the forms [nelú], [nəlú], [nélu], or [nelú] in other dialects. None of the dialects have consonant clusters; they all have either a full vowel or schwa between initial consonants. This suggests that in Patep there has been vowel neutralization rather than vowel epenthesis, since there are no related languages which do not have some kind of vowel in that position.

The pre-tonic vowel neutralization rule is, in fact, a morpheme structure rule or constraint (MSC). It fills in plus or minus feature specifications which have been left unmarked in the lexical representations. The initial unstressed vowel segments are marked only as [+syll] and the other features are left unspecified. For example, a word such as [kəpé] would have the UR /kVpe/, where V represents a [+syll] segment which becomes fully specified by the vowel neutralization rule.

An interesting aspect of the vowel neutralization analysis is its interaction with stress. Stress is predictable in terms of schwa, and the occurrence of schwa is predictable in terms of stress. But both cannot be stated as rules in terms of the other; one must operate first. If the pre-tonic vowel neutralization rule is to apply as stated above, then stress must already be marked on the morpheme. This can be done either by marking stress on each individual morpheme in the lexicon or by stating the stress rule so that it will place stress on the first fully specified vowel.

Stress placement is a crucial factor in Patep phonology. Many of the limitations in distribution of segments can be expressed in terms of stress. Perhaps what has happened

³ Jabêm is another Austronesian language which serves as a church lingua franca.

diachronically is that in an earlier stage of Patep, stress was contrastive and a fuller range of segments occurred in unstressed syllables. However, neutralization processes began to operate in unstressed syllables, producing schwa in pre-tonic syllables, and [a] in post-tonic syllables. So even though stress is now fully predictable (occurring on the first fully specified vowel), it can be considered as the primary conditioning factor for many of the phonological processes in the language.

Therefore, the solution which seems to best reflect the realities of the language is that stress is part of the underlying form of each morpheme.

Thus far the following analyses have been chosen as preferable: stress marked in UR, PreVN, and PostVN. Some sample derivations follow. Note that the neutralization rules make necessary a vowel archiphoneme (represented by V) in the UR, since the exact quality of the underlying vowel segment is unknown.

| | | | | | |
|--------|---------|-----|--------|-------|-------------|
| UR | /tVdɛV | dég | kVdĩ | míV | pVtótV/ |
| PreVN | tədɛV | — | kədĩ | — | pətótV |
| PostVN | tədə́a | — | — | mía | pətóa |
| SR | [tədə́a | dég | kədĩ | mía | pətóa] |
| | plāy | pot | get up | water | carry stick |

3. Labialization and Palatalization

Labialization occurs on a series of velar and labial consonants, viz., [p^w], [b^w], [m^w], and [k^w], [g^w], [ŋ^w]. Palatalization occurs on a series of labial and alveolar consonants, viz., [p^j], [b^j], [β^j], [m^j], and [ʋ], [d^j], [n^j]. The following restrictions apply to the vowels which may follow these labialized or palatalized consonants.

- 1) labialized velars are followed only by nonround vowels, i.e. [i e ɛ a];
- 2) palatalized labials are followed only by nonhigh, nonround vowels, i.e. [e ɛ a];
- 3) labialized labials are followed only by nonhigh, round vowels, i.e. [o ɔ];⁴
- 4) palatalized alveolars are followed by all vowels.

The labialized and palatalized consonants are restricted in their occurrence to the onset of stressed syllables, and in this position they are contrastive with their plain counterparts. There are several possible hypotheses for the labialized and palatalized consonants. These can be represented as:

$$1) \quad CV_1 \rightarrow C \begin{Bmatrix} w \\ j \end{Bmatrix} V_1, \text{ i.e. semi-vowel epenthesis}$$

⁴ There are two examples of [ɛ] following a labialized labial: [p^wɛa] 'dig' and [m^wɛa] 'barren (tree)'.

- 2) $C \begin{Bmatrix} w \\ j \end{Bmatrix} V \rightarrow CSV$, i.e. underlying semi-vowel
- 3) $CV\acute{V} \rightarrow C \begin{Bmatrix} w \\ j \end{Bmatrix} \acute{V}$, i.e. devocalization
- 4) C^* and C° i.e. underlying complex segments
- 5) A combination of the above.

The first hypothesis is that the modified (labialized and palatalized) consonants are plain consonants which have been modified by a following vowel. The weakness in this hypothesis is that the plain consonants also occur in the same environments as do the modified consonants. In stressed syllables $[m^*]$, $[k^*]$, $[\text{ɸ}]$, etc., contrast with $[m]$, $[k]$, $[t]$, etc. Also, the environments in which the modified sounds occur are often not the kind of environments which would be expected to produce labialization or palatalization. For example, while $[b^*]$ occurs only preceding round back vowels as expected, $[k^*]$ never occurs preceding round back vowels. Therefore the first hypothesis must be rejected.

The second hypothesis is that labialized and palatalized consonants represent an underlying sequence of two segments, consonant plus semivowel. This would eliminate having to posit labialized and palatalized consonants as underlying complex segments. In an analysis which includes $/w/$ and $/j/$ as underlying segments, it would not be adding any new segments.

However, one objection to this hypothesis is that there are no other consonant clusters within morphemes in the surface forms of the language. The only consonant clusters which occur are across morpheme or word boundaries, and they often have an epenthetic schwa inserted. By positing CS sequences, more complexity is being introduced in the syllable structure, and it still leaves the distributional constraints unexplained.⁵

The third hypothesis is that the labialization and palatalization represent underlying unstressed vowels which have become devocalized; i.e., in a sequence of $CV\acute{V}$, the initial V becomes devocalized to produce $C^*\acute{V}$ or $C^\circ\acute{V}$. This particular hypothesis is appealing in that it reduces the number of underlying segments by omitting the thirteen labialized and palatalized consonants as underlying segments.

Evidence for devocalization of vowels is very limited. The only vowel combinations which occur within morphemes are $[V\$a]$, where $[a]$ is the post-tonic neutralized vowel. Vowels which come together across morpheme or word boundaries are not frequent. When they do occur, they are usually both stressed, so there is no unstressed vowel to devocalize. For example, in $[\acute{a} \text{ hí } \acute{o}\eta]$ 'I hit you' $[i]$ and $[o]$ are both stressed and remain unchanged.

When the unstressed vowel in the potential aspect morpheme $/ob/$ follows a word ending in a vowel, the $[o]$ is dropped and the morpheme becomes a prefix $[b]$ on the following verb (with an epenthetic schwa inserted between the consonants).

⁵ The alternative analysis outlined in section 8 incorporates CS sequences in its morpheme structure constraints.

| | | |
|--------|------------------------------|----------------|
| /hé ob | lá/ → [hé ^m bəlá] | 'They will go' |
| they | POTEN | go |

This is not an example of devocalization, but it does show reduction of unstressed vowels.

There is at least one occurrence of devocalization of a vowel to produce labialization. When the morpheme [βəβúa] 'ridge pole/center' is combined with the compound [tátóβ] (from [tá] 'intensifier' plus [tóβ] 'long'), [a] in [tátóβ] is no longer stressed and becomes neutralized to schwa, and [u] in [βəβúa] is devocalized to produce [β^w].

[βəβúa] + [tátóβ] → [βəβ^wátətóβ] 'middle of the night'

Even though the segment [β] is not one of those which occurs labialized in other places, this example does show the devocalization of an unstressed vowel to produce labialization.

There are a few examples of palatalized or labialized sounds in Patep corresponding to vowel combinations in related dialects. These are all following labial consonants. For example, [m'á] 'mouth' in Patep corresponds to [meá], [mía] and [m'á] in other dialects. At least one other dialect has [m'biaʔ] corresponding to Patep [m'biáʔ] 'first born daughter'. [m'b'ʂʔ] 'pig' in Patep corresponds to [m'buʂʔ] in one dialect, [m'b'ʂk] in others, and [m'bʂk] in more distantly related languages. However, all of the related dialects have occurrences of [p^w] in the words [níp'ʂ] 'small' and [kəp'ʂʔ] 'old man'. Therefore, there is only limited evidence for devocalization producing labialized and palatalized labial consonants.

For labialized velars and palatalized alveolars, related dialects generally have the same forms as Patep, and some related languages have the corresponding plain consonant followed by a single vowel. For example, [k'áy] 'remove' in Patep corresponds to either [k'áC] or [káY], but never to [kuáC].

Even though evidence from morpheme alternants and related dialects is not conclusive, the devocalization hypothesis seems worth pursuing if it can provide an explanation for the restricted occurrences of the labialized and palatalized consonants and can produce a symmetrical system of underlying segments. I will follow through one possible formulation of rules.

In formalizing the rules one must decide which vowels or sets of vowels are devocalized. Is it only underlying /i/ and /u/ which devocalize to [j] and [w], or is it perhaps all front, nonlow vowels which become [j] and all round, nonlow vowels which become [w]? Or perhaps it is related to roundness, so that all nonround vowels become [j] and all round vowels become [w]? Since Patep has evidence of vowel reduction and perhaps vowel deletion in unstressed syllables, it is possible that diachronically only the high vowels were retained in unstressed syllables preceding a stressed vowel and that those in turn became devocalized.

Let us assume, then, that it is /i/ and /u/ which are devocalized to [j] and [w]. The rules for devocalization can be formulated as follows:

Labial devocalization (Dev-Lab)

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \\ \alpha\text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{syll} \\ -\alpha\text{high} \end{bmatrix} / \begin{bmatrix} +\text{cons} \\ +\text{ant} \\ -\text{cor} \end{bmatrix} \text{ — } \begin{bmatrix} +\text{syll} \\ +\text{stress} \\ -\text{high} \\ \alpha\text{round} \end{bmatrix}$$

(/i/ is devocalized to [j] preceding /e/, /ɛ/, and /a/ to produce palatalized labial consonants; /u/ is devocalized to [w] preceding /o/ and /ɔ/ to produce labialized labial consonants.)⁶

Alveolar devocalization (Dev-Alv)

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \\ -\text{round} \end{bmatrix} \rightarrow [-\text{syll}] / \begin{bmatrix} +\text{cons} \\ +\text{cor} \\ +\text{ant} \\ -\text{cont} \\ -\text{strid} \end{bmatrix} \text{ — } \begin{bmatrix} +\text{syll} \\ +\text{stress} \end{bmatrix}$$

(/i/ is devocalized to [j] to produce palatalized alveolar consonants.)

Velar devocalization (Dev-Vel)

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \\ +\text{round} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{syll} \\ -\text{high} \end{bmatrix} / \begin{bmatrix} +\text{cons} \\ -\text{cor} \\ -\text{ant} \end{bmatrix} \text{ — } \begin{bmatrix} +\text{syll} \\ +\text{stress} \\ -\text{round} \end{bmatrix}$$

(/u/ is devocalized to [w] to produce labialized velar consonants preceding [-round] vowels.)⁷

These rules account for the data and eliminate the necessity of postulating labialized and palatalized consonants as underlying segments. However, there are constraints which must be explained. The rules account for only part of the possible vowel sequences, and they account for different sequences depending on which consonant is involved. In the case of labial consonants, only sequences agreeing in roundness are accounted for; for velar consonants, however, only sequences of round followed by nonround vowels are accounted for. Velar consonants are involved only in labialization and alveolar consonants only in palatalization. The three sets of consonants each pattern in a different way.

⁶ This rule as formulated would generate [β^w]. This segment does not occur in surface forms, except for the one occurrence mentioned earlier in this section. However, Dev-Lab and Dev-Vel as stated fill in the gaps in the sets of labialized consonants and are consistent with the hypothesis presented in section 5 which posits that [w] is derived from both /β^w/ and /ɣ^w/.

⁷ This rule as formulated would generate [ɣ^w]. This segment occurs in surface forms only as a variant pronunciation of [w]. However, Dev-Lab and Dev-Alv fill in the gaps in the sets of labialized consonants and are consistent with the hypothesis presented in section 5 which posits that [w] is derived from both /β^w/ and /ɣ^w/.

Another possible treatment of the devocalization hypothesis is to set up MSCs which limit the positions in which unstressed /i/ and /u/ may occur, so that they occur only in the positions in which the devocalization occurs. A possible formulation of the MSCs follows.

$$\begin{array}{ccccccc} C & i & \acute{V} & \rightarrow & \left[\begin{array}{c} \alpha \text{cor} \\ +\text{ant} \\ -\text{strid} \end{array} \right] & & \left[\begin{array}{c} \alpha \langle -\text{high} \rangle \\ -\text{rd} \end{array} \right] \\ 1 & 2 & 3 & & 1 & 2 & 3 \end{array}$$

(If /i/ is preceded by a consonant and followed by a stressed vowel, the consonant cannot be a velar or /s/, and the vowel must be one of /e e a ə/ if the consonant is coronal.)⁸

$$\begin{array}{ccccccc} C & u & \acute{V} & \rightarrow & \left[\begin{array}{c} -\text{cor} \\ \alpha \text{ant} \end{array} \right] & & \left[\begin{array}{c} \alpha \text{round} \\ \alpha \langle -\text{high} \rangle \end{array} \right] \\ 1 & 2 & 3 & & 1 & 2 & 3 \end{array}$$

(If /u/ is preceded by a consonant and followed by a stressed vowel, the consonant must be labial or velar, and the vowel must be one of /i e e a ə/ if the consonant is velar or /o o/ if the consonant is labial.)

Note that these constraints allow the occurrence of /ɣu \acute{V} /, /βu \acute{V} /, and /li \acute{V} /. If these MSCs are accepted, then the devocalization rules can be stated as follows.

$$\left[\begin{array}{c} +\text{syll} \\ +\text{high} \end{array} \right] \rightarrow \left[-\text{syll} \right] / \text{ ____ } \left[\begin{array}{c} +\text{syll} \\ +\text{stress} \end{array} \right]$$

Patep has contrastive pairs such as [mí:a] 'water' and [m'á] 'mouth', [βí:a?] 'care for' and [β'á?] 'do well'. If the devocalization hypothesis is accepted, these can be explained as having different stress patterns in the underlying forms. In the morphemes with stress on the second vowel, the first vowel is devocalized; in morphemes with stress on the first syllable, the second vowel is neutralized to [a].

$$/míV/ \rightarrow [mía]$$

$$/kVkúV/ \rightarrow [kəkúa?]$$

$$/miá/ \rightarrow [m'á]$$

$$/kuá/ \rightarrow [k'á]$$

In summary, the devocalization hypothesis of labialized and palatalized consonants involves positing morpheme structure constraints which limit the positions in which unstressed /i/ and /u/ can occur. Following the MSCs, the devocalization rule states the environment in which these vowels are devocalized to produce labialized and palatalized consonants.

The fourth hypothesis suggested above is that C* and C' are underlying segments which occur in addition to their plain counterparts. This would mean that every phoneme in Chart

⁸ In the formulation of these rules, the convention of $\alpha \langle \text{feature} \rangle$ has been used with the following interpretation: If α is +, then the feature(s) is taken into consideration. If α is -, then the feature is irrelevant.

l would be posited as a complex underlying segment. The features [round] and [high] could be used as distinctive features to specify Patep consonants. For example, /k/, /g/, /m/, /ŋ/, etc., could be specified [-round], while /kʷ/, /gʷ/, /mʷ/, /ŋʷ/, etc., could be specified [+round]. Palatalized sounds could be specified [+high]. Palatal and velar consonants are also [+high] in Chomsky and Halle (1968); however, in Patep the feature [+high] could be reserved for palatalized sounds and not be used for velar consonants which are never palatalized.

The problem with this hypothesis is that the labialized and palatalized consonants have limited distribution, i.e., they occur only at the onset of stressed syllables and only precede certain vowels. If the analysis of Cʷ and Cj as underlying segments is accepted, then the distributional constraints on their occurrence must be viewed as MSCs and not related to any phonological rules.

The palatalized alveolar consonants are the most appealing candidates for status as complex underlying segments. They are not restricted in which vowels they may precede – any vowel may follow them. They also occur in related dialects and languages; in some they even occur word finally.

| Patep | Other Dialects | |
|---------------------|--|-----------------------|
| [ⁿ ɗia] | [ⁿ ɗin] | 'long' |
| — | [^m bán] | 'vine' |
| [hé ⁿ t] | [ⁿ dʒé ⁿ dʒ] [sé ⁿ dʒ] | 'birth position name' |
| [βəyɛʔ] | [βayát] | 'string bag' |
| — | [ɲát] | 'black' |

Hooley (1970) reconstructs an alveopalatal series of consonants in the proto language of the Buang family, of which Patep is a member. It is quite possible that the present palatalized alveolar series in Patep represents a diachronic development in which the proto alveopalatal series is fronted. Furthermore, the series has been weakened or deleted in word final and unstressed positions, and consequently only occurs initially in stressed syllables.

The final hypothesis regarding labialized and palatalized consonants is that they derive from more than one source. The most likely combination of explanations seems to be that the palatalized alveolar consonants are underlying segments and that the other modified consonants result from devocalization of /i/ and /u/ in unstressed syllables.

Regardless of which solution is chosen, there remains the problem of how to account for the distributional constraints on the labialized and palatalized consonants. There is no strong internal or external evidence to support any of the hypotheses, so the decision is heavily influenced by the underlying assumptions which the analyst has about language. If the analyst operates on the assumption that speakers systematize their underlying phonemic system and that surface irregularities are accounted for by rules, then a devocalization hypothesis is a logical choice. The constraints can be viewed as MSCs. However, if the

analyst operates on the assumption that the surface forms directly represent the speaker's phonological taxonomy (except for phonetic detail accounted for by rules), then the obvious choice seems to be that all the labialized and palatalized consonants represent underlying forms. The distributional constraints are surface structure constraints.

Based upon the scant evidence which is available, I prefer the final hypothesis; that is, that the palatalized alveolar consonants are really an alveopalatal set of underlying segments and that the other modified consonants result from devocalization of /i/ and /u/ in unstressed syllables preceding stressed vowels.

4. Length

Long vowels occur only in stressed open syllables which are morpheme final. They contrast with short vowels in that position. Only [iː], [uː] and [ɔː] occur with any frequency; [eː], [ɛː], [aː], and [oː] occur in less than ten morphemes each. One other restriction on the occurrence of long vowels is that they never occur following labialized or palatalized labial consonants. These distributional limitations suggest that perhaps the surface long vowels have different underlying forms.

I will discuss three possible hypotheses for long vowels. The first is that long vowels have derived from the loss of a consonant between unlike vowels, which have then assimilated to produce long vowels. The second is that long vowels derive from underlying vowel glides or sequences of vowel plus semivowel. The third hypothesis is that vowels are lengthened when they are in a stressed open syllable, and that the short vowels in that same position have resulted from the loss of word final /h/.

The first hypothesis can be expressed as a sequence of two processes – consonant deletion, and vowel leveling (assimilation): $V_1CV_2 \rightarrow V_1V_2 \rightarrow V_3$. These processes have not been expressed as rules, since they seem to reflect possible diachronic changes rather than synchronic processes presently at work in Patep. DeChene and Anderson (1979:520) make reference to deChene's claim that vocalic length almost always results from intervocalic consonant loss followed by assimilation of the resulting vowel sequences.

The second part of the process, that is, vowel leveling or assimilation, is not supported by internal synchronic evidence. In all sequences of unlike vowels the first vowel is stressed and the second is neutralized to [a]; there is no evidence of such a vowel sequence undergoing mutual assimilation to produce a long vowel.

The second hypothesis regarding vowel length can be formulated as follows.

Semivowel deletion (SV-Del)

$$\begin{array}{c}
 \begin{array}{c} [+syll] \left[\begin{array}{l} -cons \\ -syll \\ +voice \end{array} \right] \end{array} \rightarrow \begin{array}{c} [+long] \end{array} \emptyset / _ \# \\
 \begin{array}{cc} 1 & 2 \end{array} \qquad \begin{array}{cc} 1 & 2 \end{array}
 \end{array}$$

(A word final sequence of vowel plus semivowel becomes a lengthened vowel.)

This hypothesis offers a possible explanation for the distributional constraints on [w] and [j], since they never occur word finally. It also receives some support from related dialects, since some of them have vowel glides or vowel plus semivowel sequences word finally corresponding to Patep long vowels.

| Patep | Other dialects | |
|-------|-------------------------|------------------------|
| [nɔː] | [naʊ] [noʊ] [nɔʊ] [naː] | 'dog' |
| [jiː] | [jiɪ] [jih] [jeː] | 'spear' |
| [niː] | [neʊ] [niw] [nej] [neː] | 'second born daughter' |

It is difficult to decide whether the long vowels have resulted from deletion of the semivowel or are a result of mutual assimilation of a vowel sequence (such as described in the first hypothesis).

If the semivowel deletion hypothesis is accepted, it necessitates positing a semivowel archiphoneme in the underlying forms, since we cannot recover the quality of the putative deleted semivowel.

Even though these two hypotheses offer possible explanations for the diachronic development of long vowels in Patep, neither can be supported as a synchronic process in the language today.

The third hypothesis regarding long vowels may be expressed by the following rule.

Vowel lengthening (VLeng)

$$\begin{array}{c}
 [+syll] \rightarrow [+long] / _ \# \\
 \qquad \qquad \qquad [+stress]
 \end{array}$$

(Vowels are lengthened when they occur in stressed open syllables word finally.)

The short stressed vowels may be accounted for by the following rule, which is in a counter-feeding relationship to VLeng.

Since none of the proposed phonological rules have sufficient motivation, another possible treatment of long vowels is to state their limited distribution in an MSC. This could be done at least two different ways. One way is to mark each underlying vowel segment as either [+long] or [-long], and state in an MSC the environments in which the length specification must be [-long]. That sort of condition could be stated as follows.

$$[+syll] \rightarrow [-long] / \left\{ \begin{array}{c} \overline{[-stress]} \\ \overline{[+stress]} \end{array} \right\}^C$$

(Vowels must be short in unstressed syllables and in stressed, closed syllables.)

Another way of stating the MSC is as a positive MSC stating where long vowels may occur.

$$[+long] \Rightarrow \left[\begin{array}{c} +syll \\ +stress \end{array} \right] +$$

(The feature specification [+long] implies that the segment is a stressed vowel preceding a morpheme break.)

There doesn't seem to be any evidence to suggest which of the two MSCs is the more correct statement of the constraint.

5. Other Restricted Segments

In addition to labialized and palatalized consonants, long vowels, and schwa, there are several other segments which occur in restricted environments. These include [s], [h], [z], [j], and [w].

There seems to be interaction between [s], [z], and [h]. The segment [s] is fairly infrequent in Patep and does not occur in word final position (except in some loan words). Patep has $[V_1hV_1]$ where related dialects have word final $[V_1s]$. There is also evidence from loan phonology that the sequence $[V_1hV_1]$ is underlying final $/V_1s/$.⁹

| Tok Pisin | Patep | |
|----------------|------------|------------|
| <i>balus</i> | [bəlúhu] | 'airplane' |
| <i>kalabus</i> | [káləbúhu] | 'jail' |

The segments [h] and [s] contrast in word initial position, as in [hi] 'hit' and [si] 'roast over a fire'. However, some other occurrences of initial [h] may be derived from underlying $/s/$. Some related dialects have initial [s] where Patep has [h]. There are also correspondences between initial [h] in Patep and [z] in related dialects and languages.

It seems possible, therefore, that diachronically $/s/$ and $/z/$ account for all of the surface occurrences of [h] in Patep. However, the only apparent synchronic process in the language is that expressed in the following rule of Vowel Copy affecting final $/V_1s/$.

⁹ Note however, [kəpís] from Tok Pisin *kabis* 'cabbage'.

Vowel Copy (VC)

$$\begin{array}{c}
 \left[\begin{array}{c} +\text{cons} \\ +\text{cont} \\ -\text{voice} \end{array} \right] \# \rightarrow \left[-\text{cons} \right] \\
 \begin{array}{ccccc} 1 & 2 & 1 & 2 & 1 \end{array}
 \end{array}$$

(A word final sequence of vowel plus /s/ becomes a sequence of identical vowels separated by [h].)

The segment [z] is infrequent and occurs only in the onset of stressed syllables. In that position it contrasts with [s], [j], [ʈ], [ɖ], and other phonetically similar segments. It is always prenasalized and in that way it is similar to the voiced plosives. In word final position, some related dialects and languages have either [ʰz] or [ʰdʒ] corresponding to [ʰt] in Patep. This may be an example of word final consonant weakening, with some occurrences of word final [ʰt] in Patep having developed as a weakening of the strident [ʰz/ to the nonstrident [ʰd/ (which then becomes voiceless [ʰt] in word final position). This is a possible diachronic explanation, but there is no evidence of a present synchronic process.

One further restriction in occurrence of segments is the absence of some of the labialized and palatalized fricatives. Chart 2 shows the labialized and palatalized segments which occur.

CHART 2: LABIALIZED AND PALATALIZED CONSONANTS

| | | | |
|----------------|----------------|----------------|----------------|
| p ^w | p ^j | t ^j | k ^w |
| b ^w | b ^j | ɖ ^j | g ^w |
| | β ^j | | |
| m ^w | m ^j | n ^j | ŋ ^w |

Note the lack of [β^w], [ɣ^w], and a palatalized alveolar fricative. A possible explanation for the non-occurrence of these segments is that some occurrences of [j] and [w] may be derived from underlying palatalized and labialized consonants.

There is evidence that suggests that [w] derives from both underlying /β^w/ and /ɣ^w/. In many words with [w], the actual phonetic quality is often [ɣ^w]. This is true especially before nonround vowels. For example, [βəwéβ] 'ashes' and [βəɣ^wéβ] 'ashes' are both acceptable.

In the case of four verbs which have person prefixes, there is an alternation between [w] and [ɣ^w] for the second person forms. For example, [wa] and [ɣ^wa] are the two alternative pronunciations for the second person form for 'eat'.

/ɣam-wa/ 'you.pl-eat' → [ɣám wá]

But, /mur-wa/ 'you.dl-eat' → [múɣ^wá]

There is a further change following a morpheme ending in /ŋ/.

/oŋ-wa/ 'you.sg-eat' → [óŋɣʷá] or [óŋgʷá]

These examples suggest that the underlying form of the verb is /ɣʷa/. It should be noted that in the Buang language family one class of verbs has a labialized velar segment as the prefix marking second person. This is evidence that [w], at least in these verbs in Patep, is potentially underlyingly /ɣʷ/.

One example has been noted of [βʷ] alternating with [w]. The morpheme [wʰtótβ] is also pronounced [βʰtótβ]. Note that this occurrence of [βʷ] precedes a [+back, +round] vowel.

It seems possible, then, to posit that preceding round vowels, [w] is underlyingly /βʷ/ and that preceding nonround vowels, [w] is underlyingly /ɣʷ/. This is consistent with the occurrence of the other labialized sounds, since labialized velars occur only before nonround vowels and labialized labials occur only preceding round vowels. These two processes may be formulated as one rule.

Noncoronal Fricative Deletion (NFD)

$$\begin{bmatrix} +\text{cons} \\ +\text{cont} \\ -\text{cor} \end{bmatrix} \rightarrow \emptyset / \text{---} \begin{bmatrix} -\text{cons} \\ -\text{syll} \\ +\text{round} \end{bmatrix}$$

(/β/ and /ɣ/ are deleted preceding /w/.)

The intermediate sequences /βw/ and /ɣw/ are derived from underlying CV by devocalization, which then feeds NFD. If, however, the analysis of labialized and palatalized consonants as complex underlying segments is accepted, NFD can be retained only by expanding the labialized series to include /βʷ/ and /ɣʷ/ and by restating the rule.

The lack of a palatalized alveolar segment may be similarly explained by positing that [j] derives from an underlying palatalized alveolar consonant. The segments /s/, /z/, and /l/ are the logical ones to consider, since they are all alveolar. A palatalized lateral fricative, /lʲ/ (or possibly a palatal liquid /ʎ/) seems the most likely possibility. There is some evidence for such a sound in related languages, since there are correspondences between [j] and [ɟ], a lateral with fricative quality. Regardless of the exact phonetic quality of the segment, it seems logical that [j] does belong in the vacant position of the palatalized alveolar fricative. Since [j] occurs preceding all vowels, it has the same distribution as the other palatalized alveolar consonants.

If devocalization is accepted as the source of the palatalized alveolar consonants, [j] can be derived from underlying /li/ → /lʲ/ → [j] by a late rule. However, if the palatalized alveolar consonants are analyzed as being underlying alveopalatal segments, then /j/ simply fills the empty position in the alveopalatal column.

6. Other Rules

Three other rules may be formulated to capture phonological processes in Patep. They are Prenasalization, Consonant Devoicing, and Glottal Formation.

Prenasalization (Prenas)

$$\emptyset \rightarrow \begin{bmatrix} +\text{nasal} \\ \alpha\text{point} \end{bmatrix} / \begin{bmatrix} +\text{cons} \\ -\text{cont} \\ -\text{son} \\ +\text{voice} \\ \alpha\text{point} \end{bmatrix}$$

(A homorganic nasal is inserted preceding the voiced plosive consonants.)

Thus, the segments [b b' b^w d d' g g^w z] are always pre-nasalized.

Consonant Devoicing (CDev)

$$\begin{bmatrix} +\text{cons} \\ -\text{nas} \\ +\text{voice} \end{bmatrix} \rightarrow [-\text{voice}] / __\#$$

(Plosives and fricatives become voiceless in word final position.)

Actually, the segments begin voiced but then become voiceless. This means that the fricatives /β/, /l/, and /ɣ/ begin as voiced segments but then become voiceless. Since all of the voiced plosives are prenasalized, the nasal component of the segment remains voiced and the plosive becomes voiceless. For example, /b/ → /^mb/ → [ᵐp] in word final position. Note that CDev must follow Prenas.

Glottal Formation (ʔ-Form)

$$\begin{bmatrix} +\text{cons} \\ -\text{son} \\ -\text{ant} \\ -\text{cor} \\ -\text{voice} \end{bmatrix} \rightarrow [+low] / __\#$$

(/k/ becomes [ʔ] in word final position.)

ʔ-Form may be viewed as a further example of consonant weakening in word final position. It may also be related to neutralization in unstressed syllables, since glottal stop is the only consonant which may close unstressed syllables. However, most of the other languages in the Buang language family have either [k] or Ø corresponding to word final [ʔ] in Patep, so if neutralization is involved, it is also involved in the related languages and is not just a feature of Patep phonology.

7. Conclusion and Derivations

The following underlying segments have been posited for Patep in the preceding discussion.

| | | | | | |
|---|---|----|---|---|---|
| p | t | tʃ | k | | |
| b | d | dʒ | g | | |
| β | l | j | ɣ | i | u |
| | s | | h | e | o |
| | z | | | ɛ | ɔ |
| m | n | ɲ | ŋ | a | |

All syllabic segments are marked [±long]. Stress is marked on each morpheme.

The following phonological rules have been posited.

Labial Devocalization (Dev-Lab)

Velar Devocalization (Dev-Vel)

Noncoronal Fricative Deletion (NFD)

Pre-tonic Vowel Neutralization (PreVN)

Post-tonic Vowel Neutralization (PostVN)

Vowel Copy (VC)

Glottal Formation (ʔ-Form)

Prenasalization (Prenas)

Consonant Devoicing (CDev)

A few of the rules are crucially ordered. ʔ-Form and Prenas must precede CDev. PostVN must precede VC. Dev-Lab and Dev-Vel must precede NFD.

It may appear that there is inconsistency in the kinds of rules which have been accepted and rejected throughout this paper. Some have been rejected because they posit abstract underlying representations, while other abstract hypotheses have been accepted. The principle I have tried to follow is that an abstract underlying representation is accepted only if it is independently motivated and seems to reflect synchronic processes in the language. Several of the hypotheses have been rejected because they seem to be possible explanations of diachronic processes rather than synchronic phonological processes at work in the language today.

The remaining constraints which have not been accounted for in the rules may be accounted for in MSCs. These include the following.

- 1) Long vowels only occur in stressed, open syllables morpheme finally.
- 2) Alveopalatals (/tʃ dʒ j n/) and /z/ occur only initially in stressed syllables.

Chart 3 presents several sample derivations.

CHART 3: SAMPLE DERIVATIONS

| | /tVdÉV | dég | ŋVdáy | guá' | lVɣuá | miág | tVbÉVk/ |
|---------|---------|-------|--------|-------|-------|--------|-----------|
| Dev-Lab | — | — | — | — | — | m'ág | — |
| Dev-Vel | — | — | — | g'á' | lVɣ'á | — | — |
| NFD | — | — | — | — | lVwá | — | — |
| PreVN | tədÉV | — | ŋədáy | — | ləwá | — | təbÉVk |
| PostVN | tədəa | — | — | — | — | — | təbÉak |
| VC | — | — | — | — | — | — | — |
| ?-Form | — | — | — | — | — | — | təbÉa? |
| Prenas | tə'déa | ˈdég | ŋə'dáy | ˈg'á' | — | m'á'g | tə'mbÉa? |
| CDev | — | ˈdég | — | — | — | m'á'k | — |
| | [tə'déa | ˈdég | ŋə'dáy | ˈg'á' | ləwá | m'á'k | tə'mbÉa?] |
| | 'play | pot | rock | son.3 | liver | search | many' |
| | | | | | | | |
| | /pVlís | βiák/ | | | | | |
| Dev-Lab | — | β'ák | | | | | |
| Dev-Vel | — | — | | | | | |
| NFD | — | — | | | | | |
| PreVN | pəlís | — | | | | | |
| PostVN | — | — | | | | | |
| VC | pəlíhi | — | | | | | |
| ?-Form | — | β'á? | | | | | |
| Prenas | — | — | | | | | |
| CDev | — | — | | | | | |
| | [pəlíhi | β'á?] | | | | | |
| | 'tight | well' | | | | | |

8. An Alternative Approach

An alternative approach which seems to have merit has been suggested by Wietze Baron. It begins with a basic structure statement for Patep phonemes, which is a positive MSC stating the allowable shape of lexical entries. It corresponds to the preferred shape of morphemes given in section 1, but is stated in terms of features. The features listed are those which would need to be specified for the lexical item, and then spell-out rules complete the specification of all the segments. The basic structure specification still includes redundancies, which could be eliminated by additional segment and sequence structure rules.

Basic structure:

| | | | | | |
|---|---|--|---|---|--------------------------------------|
| $\left(\begin{array}{c} +\text{cons} \\ \text{syll} \\ \text{son} \\ \text{cont} \\ \text{ant} \\ \text{voice} \\ \text{round} \\ \text{high} \\ \text{low} \\ \text{nasal} \\ \text{strid} \end{array} \right)$ | $\left(\begin{array}{c} +\text{cons} \\ \text{syll} \\ \text{son} \\ \text{cont} \\ \text{ant} \\ \text{voice} \\ \text{round} \\ \text{high} \\ \text{low} \\ \text{nasal} \\ \text{strid} \end{array} \right)$ | $\left(\begin{array}{c} -\text{cons} \\ -\text{syll} \end{array} \right)$ | $\left(\begin{array}{c} +\text{syll} \\ \text{high} \\ \text{low} \\ \text{back} \\ \text{round} \\ \text{long} \end{array} \right)$ | $\left(\begin{array}{c} +\text{cons} \\ \text{syll} \\ \text{son} \\ \text{cont} \\ \text{ant} \\ \text{voice} \\ \text{round} \\ \text{high} \\ \text{low} \\ \text{nasal} \\ \text{strid} \end{array} \right)$ | $([+\text{syll}] ([+\text{cons}])))$ |
|---|---|--|---|---|--------------------------------------|

Included in the spell-out rules would be the following.

- 1) Two ordered rules to specify the quality of the semivowel (the third segment in the basic structure formula).
- 2) A rule to assign stress to the first [+syll] segment.
- 3) A rule to fully specify the post-tonic [+syll] segment as [a].
- 4) A rule to insert schwa between the initial consonants.
- 5) A rule to specify the last consonant segment for all features except [\pm low].
- 6) Prenasalization rule.
- 7) Final specification of glottal stop (to complete rule 5) and give the phonetic variant of /k/.
- 8) Devoicing rule.

Other rules are proposed for /h/, /s/, and /z/.

This is a very sketchy presentation of Baron's suggested solution and probably does not do it justice. However, the basic assumption he makes is that in storing lexical items speakers only employ nonredundant data, such as contained in the basic structure formula. The spell-out rules inflate this minimal information to produce fully specified matrices.

In a language such as Patep there are few alternations to use as motivation for phonological rules. Therefore the constraints in the occurrence of segments and sequences of segments are not accounted for by phonological rules as such, but by positive MSCs and related spell-out rules.

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