



- b. /ʔotʃiti-ma-raʔ-taʔ-ki]                    [ʔo. tʃi. ti .ma.-raʔ. -ta.-ki]  
 dog-not-probably-decl. modal-present  
 ‘It is probably not a dog’

(2) Shipibo                    (data from Lauriault 1948, Elías-Ulloa 2005)

- a. <sup>1</sup> [pi.-<sup>2</sup>ma-<sup>3</sup>ri.<sup>4</sup>bi.-<sup>5</sup>ki]  
 eat-causative-again-past  
 ‘He made (him) eat (it) again’
- b. <sup>1</sup> [pi-<sup>2</sup>ri.<sup>3</sup>ba.-<sup>4</sup>ki]  
 eat-again-past  
 ‘(He) ate (it) again’

Recent analyses have proposed that so-called syllable-counting alternations in Capanahua, Shipibo and other related languages are metrically sensitive (Parker 1994, 1998, González 2002, 2003, 2005, Elías-Ulloa 2005). In these languages, both phonological and morpho-phonological alternations are argued to occur in foot-sensitive positions even if secondary stresses are absent, optional, or in direct conflict with primary stress assignment.

For example, Capanahua is a trochaic language with only one stress per word and no secondary stress reported. The second syllable is stressed if heavy (as in [hi.'sis] ‘ant’); otherwise, the first syllable is stressed (as in [ʔma.po] ‘head’) (Loos 1969). All coda consonants contribute weight for purposes of stress assignment except for the glottal stop, which is pronounced in codas of strong footed (3a) and unparsed syllables (3b), but deletes in codas of weak footed syllables (3c). As shown by examples (3d, e), /ʔ/ deletion is pervasive throughout the word regardless of how many syllables there are. Glottals stop deletion is analyzed as a means of creating a prominence contrast between strong and weak syllables of a foot, which compensates for the reported lack of secondary stresses in the language (González 2002, 2003).

- (3) Capanahua<sup>3</sup>
- a. /taʔno/                    [(ʔ<sub>S</sub>taʔ. no)<sub>W</sub>]                    ‘grub’
- b. /ʔiʔsap/                    [ʔiʔ<sub>U</sub>. (ʔsa)<sub>S</sub>]                    ‘bird’
- c. /βitʃiʔ/                    [(ʔβi. tʃi)<sub>S</sub>]                    ‘I grab’
- d. /ʔotʃiti-raʔ-taʔ-ki/                    [(ʔo. tʃi) (ti ra.) (taʔ.ki)]  
 dog-probably-decl. modal-present                    <sub>S W S W S W</sub>  
 ‘It is probably a dog’

<sup>3</sup> Relative syllable prominence is indicated under the examples. From here on, ‘S’ indicates strong syllable; ‘W’ weak syllable, and ‘U’ refers to an unparsed syllable. Syllable strength is not necessarily equivalent to stress; while weak syllables are generally unstressed, strong syllables might be stressed or unstressed (González 2003).

- e. /ʔotʃiti-ma-raʔ-taʔ-ki]                      [(ʔo. tʃi.) ( ti .ma.) (raʔ. ta.) ki]  
 dog-not-probably-decl. modal-present                      S    W                      S    W                      S    W    U  
 ‘It is probably not a dog’

The case of Shipibo [riβi~riβa] is slightly different. Various proposals suggest that the distribution of this suffix is not syllable-related, but foot-related, with [riβi] occurring after a disyllabic foot (4a) and [riβa] across foot boundaries (4b). This distribution is argued to be related to sonority and prominence, with the sonority of the second vowel in the suffix matching the prominence of the syllable in which it is parsed. If the syllable is weak, the vowel will be non-sonorous /i/ (4a); if the syllable is strong, the vowel will be sonorous /a/ (4b) (González 2003, Elías-Ulloa 2005).

(4) Shipibo (from Lauriault 1948, Elías-Ulloa 2005)

- a. [(pi.-ma) (-ri.bi.)-ki]  
           S    W                      S    W    U  
 eat-causative-again-past  
 ‘He made (him) eat (it) again’
- b. [(pi-ri.) (ba.-ki)]  
           S    W                      S    W  
 eat-again-past  
 ‘(He) ate (it) again’

The fact that both phonological and morpho-phonological alternations are attested in Panoan raises the question of what the relationship between these two types of alternations is. If they are connected, what is the best analysis for morpho-phonemic alternations? This paper discusses these questions and provides a preliminary investigation of the status of morphological alternations in the grammar and their connection to the phonology of Panoan languages. It will be shown that both types of alternations are closely connected: both target the same segments, undergo the same phenomena and have a similar distribution. It will be proposed that, similar to the phonological alternations, metrically-conditioned morpho-phonological ones should be analyzed in the phonology.

This paper also provides an overview of alternations in Panoan and a discussion of various analytic possibilities for phonologically-conditioned allomorphy, focusing on the Yaminahua suffix [tiʃo ~ toʃi] ‘on arriving’. Like Shipibo [riβi ~ riβa] ‘again’, the vowels in this suffix alternate according to their sonority and syllable prominence; however, both vowels alternate in this case, making an excellent test case for various possibilities of analysis.

The remainder of this paper is organized as follows. Section 2 provides data on phonological alternations in Panoan, and section 3 on morpho-phonological cases. A close look at these

alternations shows that both types are connected as to types of segments targeted, distribution and conditioning; this is discussed in detail in section 4, which also argues in favor of a generalized metrical approach to these alternations. Section 5 focuses on morpho–phonemic alternations and various possibilities for their analysis. Finally, section 6 is the conclusion.

## 2. PHONOLOGICAL ALTERNATIONS IN PANOAN

Sections 2 and 3 present an overview of the phonological and morpho–phonological alternations that have been reported in Panoan. At least eight out of the thirty Panoan languages have alternations that have been previously described as dependent on syllable count.<sup>4</sup> Table 1 lists phonological alternations that are reportedly of this type.

Table 1. Phonemic alternations in Panoan <sup>5</sup>

LANGUAGE	SEGMENT	PROCESS	CONTEXT	REFERENCES
Capanahua	/?/	Deletion	Coda (weak $\sigma$ )	Loos (1969), Safir (1979), González (2002, 2003)
		Metathesis	Onset–to–coda (strong $\sigma$ )	Loos and Loos (1998), González (2003)
Huariapano	[h]	Epenthesis	Coda (strong $\sigma$ )	Parker (1994, 1998), González (2003)
Amahuaca	/n/	Deletion	Coda (strong $\sigma$ )	Osborn (1948), Young de Hyde (1973), Shell (1975), Russell (1975), Hyde (1980), Loos (1999)
	/m, n/	Plosive release	Foot medial onset	
	/p, t, k/	Plosive voicing	Foot initial onset	
	ĩ+/p, t, k/	Nasal gliding	Foot medial coda?	

The phonological alternations listed in Table 1 are caused by the interaction of conflicting phonological forces. For example, in Capanahua, /ʔ/ occurs in coda of strong and unparsed syllables, but deletes in coda of weak footed syllables (3). Additionally, a glottal stop in onset of strong syllable metathesizes to the coda of the same syllable (5a); when the strong syllable already has a coda /ʔ/, onset /ʔ/ deletes (5b) (Loos and Loos 1998, González 2002, 2003).

- (5) Capanahua metathesis (from Loos and Loos 1998:21, 22)
- a. /ketsin–ʔino/ [ke. (tʃĩ.) (ĩʔ. no)] ‘Painted tiger’<sup>6</sup>  
U S S W
- b. /toaʔiʔka/ [(tʔ. a.) (iʔ. ka)] ‘Mattress’  
S W S W

<sup>4</sup> Panoan languages are spoken in Peru, Bolivia and Brazil. For an overview, see Grimes (1998) and Loos (1999).

<sup>5</sup> Yaminahua has a [k]~[ʔ] alternation that, even if not clearly metrical, is similar to metathesis of /ʔ/ in Capanahua (see below). For details see Eakin (1991), Faust and Loos (2002) and González (2005). According to Kneeland (1979), Mayoruna (Matses) has a similar alternation. However, Fleck (2004) notes that /k/ is pronounced [ʔ] word–finally and [k] elsewhere.

<sup>6</sup> Nasals delete in coda position, nasalizing preceding and following vowels. For details see Loos (1969).

Deletion and metathesis of /ʔ/ in Capanahua are related to the lack of secondary stresses in the language. Both phenomena appear to create a prominence contrast between strong and weak syllables within a foot. This is interpreted as rhythmicity in the absence of secondary stress (González 2002, 2003). Rhythmicity refers to foot-based prominence, which creates a contrast between strong and weak syllables by way of strengthening the strong syllable, reducing the weak syllable, or both, with or without reference to stress (for discussion see González 2003).

Huariapano (extinct since 1991) is also a trochaic language where metrically-sensitive alternations conflict with stress assignment. Primary stress is quantity-sensitive and is assigned to the rightmost moraic trochee, as in [(<sup>1</sup>hi.wi)] ‘branch’, [ja. (<sup>1</sup>wiʃ)] ‘opossum’ (Parker 1998:2–5). However, secondary stress is quantity-insensitive and assigned to syllabic trochees, either left-to-right, as in [(<sub>s</sub>ku.βjaj.) βa. (<sup>1</sup>ʃi.ki)] ‘I cooked’, or right-to-left, as in [βis.(<sub>s</sub>ma.noh.) (<sub>s</sub>ko.no.) (<sup>1</sup>ʃi.ki)] ‘I forgot’. The left-to-right pattern is more common (66%), while the right-to-left pattern occurs about 34% of the time (Parker 1998:6–10).

In Huariapano, [h] epenthesis occurs in codas before voiceless consonants, provided the syllable is strong (6a, b). Note that in (6b) the first syllable is strong but has not secondary stress; this avoids a clash with main stress in the following syllable. [h] is not inserted in the coda of weak syllables (6c). Note that the final syllable in (6c) is unparsed; this is a light syllable that cannot be parsed with the heavy penultimate syllable, since coda consonants are moraic and feet have at most two moras in Huariapano (Parker 1994, 1998; see also González 2003).

(6) Huariapano epenthesis	(from Parker 1994:100, 102)
a. ( <sub>s</sub> βi <sup>h</sup> .t <sub>w</sub> sa.) ( <sup>1</sup> kan.) ki	‘They laughed’
b. ( <sub>s</sub> ku <sup>h</sup> .) ( <sup>1</sup> p <sub>s</sub> un)	‘I open’
c. ( <sub>s</sub> iʃ.t <sub>w</sub> o.) ki. ( <sup>1</sup> ra <sub>s</sub> ŋ.) ki	‘Came running’

In Huariapano there is a clash between primary and secondary stress; primary stress is assigned to the rightmost foot and is quantity-sensitive, while secondary stress is assigned from the left and is quantity-insensitive. [h] insertion follows the distribution of the main pattern of secondary stress. This explains the fact that is restricted to odd numbered syllables, and that does not apply in initial syllables with main stress (as in [<sup>1</sup>pi.ku] ‘He ate’). It is prominence-driven in the sense that it makes strong syllables stronger by providing a laryngeal coda, and in cases such as (6b) it parses syllables into feet that would otherwise remain unparsed (González 2003).

Note that the alternations in Table 1 involve glottal consonants and, in the case of Amahuaca, nasals and voiceless stops. While the cases of Capanahua and Huariapano are relatively well understood, Amahuaca remains to be studied in more detail.

## 3. MORPHO-PHONOLOGICAL ALTERNATIONS IN PANOAN

Foot-sensitive morpho-phonological alternations in Panoan appear to be more widespread than phonological alternations. They can target consonants, vowels or full syllables. Table 2 shows the consonantal morpho-phonemic alternations found in Panoan.

Table 2. Morpho-phonemic alternations in Panoan: consonants

LANGUAGE	ALTERNATION		GLOSS	REFERENCES
Yaminahua	<u>Even</u>	<u>Odd</u>		
	[- <u>ji</u> ]	[- <u>jin</u> ]	‘Nightly’	Eakin (1991), Faust and Loos (2002)
	[- <u>fai</u> ]	[- <u>fain</u> ]	‘Daily’	González (2005)
	[- <u>ʂo</u> ]	[- <u>ʂon</u> ]	<i>Benefactive</i>	
	[- <u>ma</u> ]	[- <u>man</u> ]	<i>Causative</i>	
Amahuaca	<u>After even</u>	<u>After odd</u>		Osborn (1948), Young de Hyde (1973), Shell (1975), Russell (1975), Hyde (1980), Loos (1999)
	[- <u>paʔon</u> ]	[- <u>panʔ</u> ]	‘A lot’	
	[- <u>βaʔin</u> ]	[- <u>βanʔ</u> ]	‘To go (iterative)’	
	[- <u>kaʔin</u> ]	[- <u>kanʔ</u> ]	‘To come’	
	[- <u>βuran</u> ]	[- <u>βunʔran</u> ]	<i>Nexus</i>	
	[- <u>kiran</u> ]	[- <u>kinʔran</u> ]	<i>Nexus</i>	
Shipibo	[- <u>keet</u> ]	[- <u>eet</u> ] [- <u>iit</u> ]	<i>Reflexive</i> ( <i>intrans.</i> )	Faust (1973)
	[- <u>koot</u> ] [- <u>kiit</u> ]	[- <u>meet</u> ]		
	<u>After even</u>	<u>After odd</u>		
	[- <u>katitai</u> ]	[- <u>katiai</u> ]	<i>Imperfect past</i>	

An example concerning the Yaminahua suffix [fain ~ fai] ‘daily’ is given in (7). Prevocally, [-fai] occurs if the suffix is even-numbered in the word, [-fain] if odd-numbered (Faust and Loos 2002). See section 4 for a detailed discussion of related suffixes.

(7) Yaminahua [fain ~ fai] ‘daily’ (data from Faust and Loos 2002:108, 135)

- a. /o-<sup>1</sup>fai<sup>2</sup><sup>3</sup>-i/ [‘o.faĩ]<sup>7</sup>  
 come-daily-progressive  
 ‘Is coming daily’
- b. /o<sup>1</sup>ʂa<sup>2</sup>-fai<sup>3</sup><sup>4</sup>-a/ [‘o.ʂa.fai.na]  
 sleep-daily-past  
 ‘Slept during the day’

The alternations in Table 2 might target nasals (as in Yaminahua), glottal consonants and nasals (in Amahuaca), and voiceless stops and nasals (in Shipibo). These consonants are targeted also by phonological alternations (cf. Table 1). Deletion or epenthesis takes place in Yaminahua, Shipibo and Amahuaca; in Amahuaca, some suffixes appear to involve metathesis (together with vocalic deletion). These phenomena are also characteristic of phonological alternations (Table 1).

<sup>7</sup> Vowel merging has applied word finally.

Vocalic morpho–phonological alternations are shown in Table 3. They mainly involve deletion and/or epenthesis. Reduplication is found in Amahuaca negation and in the future indefinite in Yaminahua. Vocalic alternations occur in the Shipibo suffixes [riβi ~ riβa] ‘again’ (see 2, 4) and the transitive subject, and in the Yaminahua suffix [tiʃo ~ toʃi] ‘on arriving’.

The Yaminahua suffix [tiʃo ~ toʃi] ‘on arriving’ alternates in practically the same way as [riβi ~ riβa] ‘again’ in Shipibo. Unlike the Shipibo morpheme, both vowels in the morpheme alternate. This suffix will be considered in detail in section 5 in this paper. The morpho–phonological alternations in Amahuaca, Sharanawa, Shanenawa, Yaminahua and Matis remain to be investigated in more detail.

Some morpho–phonological alternations might target full syllables (Table 4). Among these cases the main phenomena is once again deletion/epenthesis. Metathesis is found in the Shanenawa recent past suffix, and cases of suppletion appear in the transitive subject and ‘towards’ suffixes in Shipibo.

Table 3: Morpho–phonemic alternations in Panoan: vowels

LANGUAGE	ALTERNATION		GLOSS	REFERENCES
	V → VV/ _ [-ma]		<i>Negation</i>	
Amahuaca	<u>After even</u> [-pai] [-jo]	<u>After odd</u> [-pa] [-joo]	‘Right now’ <i>Desiderative</i>	Russell (1975)
Shipibo	<u>After even</u> [-riβi] [-kiin] [-naan] ~ [-n] [-n] ~ [-an] ~ [-en]	<u>After odd</u> [-riβa] [-kin] [-Vnaan] ~ [-Vn] [-nin]	‘Again’ ‘To help’ ‘Against’ Trans. subject	Lauriault (1948), Faust (1973), González (2003), Elías-Ulloa (2005)
Yaminahua	<u>After even</u> [-toʃi] [-~] [- nã]	<u>After odd</u> [-tiʃo] V → VV/ _ [-ʃi] [-ã] [- anã]	‘On arriving’ <i>Future def.</i> ‘Against’ <i>Reciprocal</i>	Eakin (1991), Faust and Loos (2002), González (2005)
Matis	<u>Non-final syllable</u> [-tapa] ~ [-dapa]	<u>Final syllable</u> [-tap] ~ [-dap]	<i>Emphatic</i>	Spanghero Ferreira (2000)

Table 4: Morpho–phonemic alternations in Panoan: syllables

LANGUAGE	ALTERNATION		GLOSS	REFERENCES
Sharanawa	<u>After even</u> [-paku]	<u>After odd</u> [-pa]	‘All’	Loos (1999)
Shanenawa	[-šina] [-šuna]	[-šian] [-šun]	<i>Recent past</i> <i>Benefactive</i>	Cândido (2004)
Yaminahua	[-pake] [-tai]	[-pa] [-titai]	‘Going down’ ‘Always’	Eakin (1991), Faust and Loos (2002)
Amahuaca	[-ma] [-ʔaʃ] [-ʔnaja]	[-mama] [-noʔaʃ] [-jaa]	<i>Negation</i> <i>Origin</i>	Russell (1975)
Shipibo	[-anan] [-nko] [-n]	[-ananan] [-ain] [-nin]	<i>Reciprocal</i> ‘Towards’ <i>Transitive subject</i>	Faust (1973)

One example of a syllabic alternation is given for the Yaminahua suffix [pake ~ pa] ‘going down’ (8). According to Faust and Loos (2002:132), [pa] occurs if the first syllable of the suffix is even–numbered, and [pake] elsewhere. González (2005) proposes a metrical analysis of this distribution, with [pake] occurring after dysyllabic feet, and [pa] otherwise.

- (8) {-pake, -pa} (from Faust and Loos 2002:132)
- a. /ka-pake-ni/ [(ka.pa.) ni]  
go-down-remote past  
‘Went down’
- b. /kene-pake-ni/ [(ke.ne.) (pa.ke.) ni]  
write-in order-remote past  
‘Wrote in order’

Phonological and morpho–phonological alternations in Panoan share some similarities. Both kinds alternate according to the metrical structure of the language, with some allomorphs/allophones occurring in weak syllables, and some in strong and unfooted syllables. They undergo similar phenomena, mainly epenthesis, deletion and metathesis. Additionally, consonantal alternations in Panoan involve the same segments: glottals, nasals, and voiceless stops, regardless of whether they are phonological or morpho–phonological (Panoan consonant inventories also have fricatives, approximants, and liquids). There are also some differences. While phonological alternations typically involve consonants, morpho–phonological ones can involve vowels, consonants, or full syllables.

#### 4. ON THE RELATIONSHIP BETWEEN PHONOLOGICAL AND MORPHO–PHONOLOGICAL ALTERNATIONS

The influence of phonological forces in morpho–phonological alternations is open to discussion. Paster’s (2005) survey on syllable–counting allomorphy shows that not all cases are motivated

by output optimization, that is, independently motivated by phonological well-formedness (cf. Kager 1996). She finds that both output optimizing and non-optimizing syllable-counting allomorphy are attested. Paster proposes that in order to account for both instances of syllable-counting allomorphy, both output optimizing and non-optimizing cases should be considered as allomorphs being subcategorized in different contexts. Subcategorization refers to the inclusion in the representation of an affix of a requirement for the stems to which the affix will attach (Lieber 1980, Kiparsky 1982, among others).

For Panoan, this would mean treating alternations in a way akin to the descriptive generalizations put forth by Loos (1999) and previous literature; some allomorphs are subcategorized in odd-numbered syllables and others in even-numbered syllables. One could be more sophisticated and state that some alternations are subcategorized by a disyllabic foot, or maybe, even, by unfooted syllables.

A general problem with a subcategorization approach to alternations is that it is merely descriptive; it lacks explanatory power. Reducing all cases of syllable counting (or other type of) allomorphy to subcategorization regardless of whether output optimization is relevant or not takes away the explanation that phonology can contribute to at least a subset of those alternations.

In the case of Panoan, such an approach runs into additional problems. To begin with, it misses the connection between phonological and morpho-phonological alternations; as noted in the previous section, both kinds of alternations involve the same segments (notably glottals, nasals and voiceless stops), the same phenomena (mainly, deletion, epenthesis and metathesis), and the same distribution (generally, strong footed syllables vs. weak syllables). Surely it is not a coincidence that the same segments, phenomena and contexts appear again and again. If morpho-phonological alternations are dealt with as mere instances of subcategorization, important generalizations and connections are missed not only in the Panoan cases, but potentially in the whole typology of alternations.

Additionally, different predictions are made by the subcategorization and the metrical approach. A subcategorization approach predicts that any type of allomorph can potentially occur in any prosodic context, regardless of whether it is strong or weak. Thus, stronger allomorphs might match or not with stronger positions, and weaker allomorphs might match or not with weaker positions. The metrical approach predicts that stronger allomorphs will occur in stronger positions while weaker allomorphs occur in weaker positions. Strong positions might include not only stressed syllables, but also heads of metrical feet even in the absence of stress (cf. González 2003). In the same vein, weak positions might be unstressed syllables or non-head syllables parsed in a metrical foot.

One interesting test case for both predictions involves a group of suffixes in Yaminahua, a trochaic language with only one stress per word. These suffixes, {ʃin~ʃi} ‘nightly’, {fain~fai} ‘daily’, {ʃon~ʃo} ‘benefactive’, and {man~ma} ‘causative’, are reported to alternate with consideration to two matters: whether they precede a vowel or a consonant, and, in the first case, whether the suffix occurs in an even or odd-numbered syllable.



This situation is not problematic for a subcategorization approach, which predicts that any allomorph might occur in any position. However, it is a problem for the metrical approach. But the apparently strange situation of these suffixes can be explained through the interaction of various phonological forces. One is foot alignment. The suffixes {ʃin~ʃi}, {fain~fai}, {ʃon~ʃo} and {man~ma} are aligned to the right edge of a foot. This requirement conflicts with a tendency in Yaminahua to avoid unparsed and onsetless final syllables. When an alignment violation cannot rescue an unparsed or onsetless final syllable, /n/ will surface (as [n] or [d]), as in [(ke.ne.) (ʃo.da)] (rather than \*[(ke.ne.) (ʃo.a)] or \*[(ke.ne.) (ʃo.a)]). Otherwise /n/ does not surface, as in [(fe.ʃõ a)] (rather than \*[(fe.ʃõ.) a]). The reader is referred to González (2005) for further detail.

The moral of the story is that metrical motivations (either prominence-related or foot-alignment related) seem to be behind so-called syllable-counting allomorphy in Panoan. The case of these Yaminahua suffixes is not an isolated fact in Panoan; as noted above, Amahuaca has a number of phonological alternations involving nasals that alternate in a metrical fashion. Other cases seem more difficult to explain. An example is the Shipibo suffix ‘towards’, that can be realized as [-ain] or [-nko] (Faust 1973:58–9). [-ain] reportedly occurs after odd-numbered syllables (11a, b) and also after a syllable ending in a nasal vowel (11c), a stressed vowel (11d) or a consonant (11e). The allomorph [-nko] occurs after words with even-numbered syllables that end in oral and unstressed vowels (11f, g).

- |      |                     |                        |                  |
|------|---------------------|------------------------|------------------|
| (11) | Shipibo {ain~nko}   | (from Faust 1973:58–9) |                  |
| a.   | /i–{ain~nko}/       | [ị.ˈã.ĩn]             | ‘to the field’   |
| b.   | /ikito–{ain~nko}/   | [i.ˈki.to.ain]         | ‘to Iquitos’     |
| c.   | /jarin–{ain~nko}/   | [ja.ˈrĩ.ã.ĩn]          | ‘to Yarina’      |
| d.   | /belen–{ain~nko}/   | [be.ˈlẽ.ã.ĩn]          | ‘to Belén’       |
| e.   | /roj–{ain~nko}/     | [ro.jã.ĩn]             | ‘to Royá’        |
| f.   | /jema–{ain~nko}/    | [ˈje.man.ko]           | ‘to the village’ |
| g.   | /masisia–{ain~nko}/ | [ma.ˈsi.si.an.ko]      | ‘to Masisa’      |

The distribution of the allomorphs in (11) needs to be investigated in detail. While the context of occurrence of [ain ~ nko] seems to be related to stress and/or footing, it is not yet clear why each suffix is chosen in each case. In the case that further investigation of this or other similar cases determines that no direct relationship exists between the shape of each allomorph and their distribution, a possible explanation might be that the morphemes are in the way of becoming fossilized.

It is indeed likely that obscure cases of allomorphy where no output optimization occurs are cases of fossilized morphemes that previously had a clear phonological motivation. However, as shown in this section, many of the so-called syllable-counting allomorphy cases found in Panoan seem to be metrically motivated, and thus, a phonological approach that explains these cases is preferable to a subcategorization approach.

## 5. THE ANALYSIS OF MORPHO-PHONEMIC ALTERNATIONS

A related question is how morpho-phonemic alternations should be analyzed. Various approaches have been taken. One is morpheme suppletion. This approach considers lexical entries to be sets of allomorphic alternates (Hudson 1974, Hooper 1976). Rules or constraints would then select the attested form in the right environment (for this approach using constraints, see for example Kager 1996). A second approach is to consider one of the allomorphs as basic, with morpheme-specific constraints or rules selecting or deriving the attested allomorph in the right environment (for this approach using rules, see Chomsky and Halle 1968).<sup>8</sup>

This section compares the first two approaches (morpheme suppletion and the selection of a basic allomorph) within the constraint-based approach of Optimality Theory (Prince and Smolensky 1993). The example that will be focused on is the suffix [tiʃo ~ toʃi] ‘on arriving’ in Yaminahua.<sup>9</sup> This suffix is reportedly pronounced [toʃi] when preceded by an even number of syllables (12a), and [tiʃo] when preceded by an odd number of syllables (12b) (Faust and Loos 2002:134). As mentioned before, Yaminahua is a trochaic language with only one stress per word, usually on the first syllable of the word.

(12) Yaminahua [tiʃo]~[toʃi] (from Faust and Loos 2002:134)

- |                         |                              |
|-------------------------|------------------------------|
| a. /fitʃi-toʃi-a-fo/    | [('fi.tʃi). (to.ʃi.) (a.fo)] |
| find-arrive-past-plural | ‘Found on arriving’          |
| b. /fa-toʃi-ita/        | [('fa.ti.) (ʃo.i).ta]        |
| say-arrive-yesterday    | ‘Said on arriving’           |

This alternation is strikingly similar to [riβi ~ riβa] ‘again’ in Shipibo (Lauriault 1948, González 2003, Elías-Ulloa 2005), with a twist: both vowels in the Yaminahua suffix alternate. As proposed in González (2005), this alternation is related to the alignment of vocalic sonority within the suffix with foot prominence. The relatively sonorous vowel /o/ is aligned with a strong footed syllable, while less sonorous /i/ is aligned with a weak syllable. This is shown schematically in (13).

(13) Vocalic sonority and prominence

□	/t...ʃ.../	□
[o]		[i]
Prominent syllable		Non-prominent syllable

<sup>8</sup> A third approach that will not be pursued here involves underspecification. Under such an approach, a morpheme would be underspecified as to some features or alternants, with rules or constraints providing the full form.

<sup>9</sup> An analysis in OT was sketched before for this suffix in González (2005); it is developed here in more detail.

But how can be this alternation best represented? One option is to assume that lexical entries are sets of allomorphic alternates (Hudson 1974, Hooper 1976). Thus, ‘on arriving’ in Yaminahua would have two forms: {toʃi ~ tiʃo}. The interaction of universal constraints in the grammar of Yaminahua selects the right candidate in the right context, as will be shown below.

The insight that the vowels in {toʃi ~ tiʃo} are aligned with foot positions according to their sonority can be captured with the help of two prominence scales: one for metrical feet, and one for vowels (14).

- (14) Prominence scales
- |               |   |                           |
|---------------|---|---------------------------|
| <u>Feet</u>   | Head <sub>prom</sub> > weak                     | (Kenstowicz 1996)         |
| <u>Vowels</u> | a <sub>prom</sub> > e, o <sub>prom</sub> > i, u | (Prince & Smolenksy 1993) |

The prominence scales in (14) can be combined to form the universal constraint hierarchies in (15), which basically ensure that vowels in prominent syllables are as prominent (sonorous) as possible, while the opposite situation holds in non-prominent syllables (González 2003 and references therein). Note that prominent syllables are heads of a metrical foot, regardless of whether they are stressed or not, and that non-prominent syllables are weak syllables of a metrical foot.

- (15) Constraint hierarchies
- a. \*HEAD/i, u >> \*HEAD/e, o >> \*HEAD/a  
Vowels in head syllables are as sonorous as possible
  - b. \*WEAK/a >> \*WEAK/e, o >> \*WEAK/i, u  
Vowels in weak syllables are as non-sonorous as possible

The constraints \*WEAK/o and \*HEAD/i ensure that the right forms are selected for the suffix {toʃi ~ tiʃo}. \*WEAK/o and \*HEAD/i are outranked by faithfulness constraints in Yaminahua, since there is no general restriction that [o] is forbidden in weak syllables and [i] in strong syllables. This is shown in (16), where all of the vowels in the word /kirika/ ‘book’ surface faithfully, in spite of the fact that the optimal candidate (a) has a violation of \*HEAD/i.

- (16) FAITH >> \*WEAK/o, \*HEAD/i

/kirika/ ‘book’	FAITH	*WEAK/o	*HEAD/i
☞ a. ('ki.ri.) ka			*
b. ('ko.ri.) ka	*!		
c. ('ki.ro.) ka	*!	*	*
d. ('ko.ro.) ka	*!*	*	

However, the situation for the suffix ‘on arriving’ is different. Since the input for this suffix consists of two allomorphs, {tiʃo ~ toʃi}, faithfulness is not violated, and the choice of vowels is left to lower-ranked \*WEAK/o and \*HEAD/i (16). Candidate (a) in (17) is optimal, since the

sonority of both morpheme vowels is perfectly aligned with foot prominence. Note that under this analysis, candidates (c, d), where both vowels in the surface are the same fare badly. These two candidates not only incur violations of \*WEAK/o, \*HEAD/i; they also fatally violate FAITH.

(17) [tiʃo] selected

/fa- <u>{tiʃo ~ toʃi}</u> -ita/	FAITH	*WEAK/o	*HEAD/i
☞ a. ('fa.ti.) (ʃo.i) ta			
b. ('fa.to) (ʃi.i) ta		*!	*
c. ('fa.to) (ʃo.i) ta	*!	*	
d. ('fa.ti) (ʃi.i) ta	*!		*

The same observations hold for (18). Candidate (a) has two violations of \*WEAK/o (in the second and third foot), and two violations of \*HEAD/i (in the first and second foot). Candidate (b) has one violation of WEAK/o and of \*HEAD/i (in the last and first foot respectively). Candidate (a) fares worse, with two violations of each constraint. Candidates (c, d) violate FAITH, so candidate (b) is selected as optimal.

(18) [toʃi] selected

/fitsi- <u>{tiso ~ tosi}</u> -afo/	FAITH	*WEAK/o	*HEAD/i
a. ('fi.tsi.) (ti.ʃo.) (a.fo)		*!*	**
☞ b. ('fi.tsi.) (to.ʃi.) (a.fo)		*	*
c. ('fi.tsi.) (to.ʃo.) (a.fo)	*!	**	*
d. ('fi.tsi.) (ti.ʃi.) (a.fo)	*!	*	**

In conclusion, an approach that makes use of suppletive inputs and phonological constraints captures the phonological conditioning of the {tiʃo ~ toʃi} allomorphy. Further, since \*WEAK/o and \*HEAD/i are outranked by FAITH, it ensures that the alternation between /o/ and /i/ in strong and weak syllables is not enforced generally in Yaminahua.

One alternative is an approach with single inputs. Under this approach, a single allomorph is considered as the input at a given time, with morpheme-specific constraints selecting the right form. A primary drawback for this option is that constraints in OT are universal. If morpheme-specific, language-specific constraints are allowed, the universal appeal of OT is somewhat diminished.

One morpheme-specific constraint could be posited for the Yaminahua suffix 'on arriving'. However, both vowels in this morpheme alternate, and two possible inputs have to be allowed: /tiʃo/ and /toʃi/. If the connection between sonority and foot prominence is kept, two separate constraints are needed, perhaps along the lines of (19).

(19) Morpheme-specific constraints for 'on arriving'

- a. \*(tiʃo)<sub>F</sub> [tiʃo] occurs only across a foot boundary

- b.  $*(\dots\text{to})_F (\text{fi}\dots)_F$  [tofi] occurs only within a foot

The formulation of the morpheme-specific constraints in (19) is somewhat similar to subcategorization: specific allomorphs are prohibited in specific contexts. There might be better possibilities of formulating these constraints. However, regardless of how precisely the constraints are formulated the fact remains that two separate constraints are needed for one single morpheme, which is troubling.

The constraints in (19) need to outrank FAITH. Since there are two possible inputs to consider (/tifo/ and /tofi/), we need to ensure that output constraints rather than faithfulness drive the alternation. The ranking  $*(\text{tifo})_F, *(\dots\text{to})_F (\text{fi}\dots)_F \gg \text{FAITH}$  obtains the right results in (20–21), where the input and output coincide.

- (20) Input /tifo/ – optimal output [tifo] selected

/fa– tifo –ita/	$*(\text{tifo})_F$	$*(\dots\text{to})_F (\text{fi}\dots)_F$	FAITH
☞ a. ('fa.ti.) (fo.i.) ta			
b. ('fa.to) (fi.i) ta		*!	
c. ('fa.to) (fo.i) ta			*!
d. ('fa.ti) (fi.i) ta			*!

- (21) Input /tofi/ – optimal output [tofi] selected

/fitsi– tofi –afo/	$*(\text{tifo})_F$	$*(\dots\text{to})_F (\text{fi}\dots)_F$	FAITH
a. ('fi.tsi.) (ti.fo.) (a.fo)	*		**
☞ b. ('fi.tsi.) (to.fi.) (a.fo)			
c. ('fi.tsi.) (to.fo.) (a.fo)			*!
d. ('fi.tsi.) (ti.fi.) (a.fo)			*!

However, there are problems when the input and output for this suffix do not coincide. In (22), candidates (c, d) harmonically bind the optimal candidate, which has two violations of FAITH. Regardless of the ranking between the morpheme-specific constraints  $*(\text{tifo})_F$  and  $*(\dots\text{to})_F (\text{fi}\dots)_F$  and FAITH, the optimal candidate will never win over candidates (c, d), which have only one violation of FAITH.

- (22) Problem 1: Input /tofi/ – optimal output [tifo] not selected

/fa– tofi –ita/	$*(\text{tifo})_F$	$*(\dots\text{to})_F (\text{fi}\dots)_F$	FAITH
⊗ a. ('fa.ti.) (fo.i.) ta			**
b. ('fa.to) (fi.i) ta		*!	
☞ c. ('fa.to) (fo.i) ta			*!
☞ d. ('fa.ti) (fi.i) ta			*!

A similar problem arises when the input /tʃo/ and the output [toʃi] are matched (23). Candidates (c, d) only have one violation of FAITH, and thus they harmonically bind the optimal candidate (b), which violates FAITH twice. Regardless of the ranking between the constraints shown in the tableau, the optimal candidate loses in the evaluation. In conclusion, not only is the morpheme-specific constraint solution problematic for a theory with universal constraints, in this case, at least, it does not work.

(23) Problem 2: Input /tʃo/ – optimal output [toʃi] not selected

/fitsi– tʃo –afo/	*(tʃo) <sub>F</sub>	*(...to) <sub>F</sub> (ʃi...) <sub>F</sub>	FAITH
a. ('fi.tsi.) ( <u>ti</u> .ʃo.) (a.fo)	*!		
⊗ b. ('fi.tsi.) (to.ʃi.)(a.fo)			*!*
☞ c. ('fi.tsi.) ( <u>to</u> .ʃo.)(a.fo)			*!
☞ d. ('fi.tsi.) ( <u>ti</u> .ʃi.) (a.fo)			*!

## 6. DISCUSSION

This paper has explored some issues connected to so-called syllable-counting alternations in Panoan. An overview of both morpho-phonological and phonological alternations of this type shows that both are connected; crucially, both types involve the same consonantal segments, undergo the same phenomena, and share a similar, metrically-sensitive distribution by which some allophones and allomorphs occur in weak or strong positions within the metrical foot, or are selected by foot-alignment constraints. Some differences exist, mainly in the fact that morpho-phonemic alternations also target vowels and syllables.

The similarities between both types of alternations were argued to be best captured through the interaction of phonological tendencies rather than consider them as cases of subcategorization. Different approaches towards the analysis of phonologically-conditioned allomorphy were outlined, focusing on the Yaminahua suffix {tʃo~toʃo} ‘on arriving’. Out of these options, a suppletion analysis with universal constraints was argued to be preferable to one using single inputs and morpheme-specific constraints.

Among the topics that require further investigation are, first of all, the reasons why glottals, nasals and voiceless stops are more prone to undergo alternations. It is expected that the widespread occurrence of glottals in alternations is related to the development of tone and stress assignment in Panoan (for a preliminary approach see González 2003). Additionally, there is a close connection between laryngeals and stress; variations of pitch/stress are partly due to changes in laryngeal behavior (Ladefoged 1993). Further, these consonants lack supra-laryngeal features, they are plausibly easier to delete, insert, and relocate (Steriade 1987, Yip 1991, Rose 1996, among others). It is unclear, though, why nasals and voiceless stops should undergo alternations while fricatives, approximants and liquids do not, and it is hoped that further research clarifies this question.

It has also to be explored whether any type of morpheme is more likely to alternate in Panoan, and if so, why. For example, a number of alternating morphemes in Tables 2–4 are aspectual or durational. It is quite likely that certain alternating morphemes, including the suffix [–pake ~pa] ‘going down’ in Yaminahua, originate from previously independent verbs that developed into verbal affixes (Faust and Loos 2002:132–3), and that this is somehow related to the alternation itself.

Ultimately, there is the question of the origin of these alternations and their connection to foot-sensitive positions with no direct reference to stress. It is expected that an in-depth analysis of these alternations will reveal the answers to these questions and inform our understanding on the nature of the phonology and morphology interface.

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