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PHONETIC CORRELATES OF STRESS AND TONE IN A MIXED SYSTEM

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The description of Atlantic Creoles has relied mostly on comparative studies with intonational languages. However, there are few corresponding tonal properties between Atlantic Creoles with tonal systems and their Indo-European lexifiers. The description of the tonal systems of these Creoles must precede any comparative study with intonational languages. This research supplements previous phonological descriptions of Papiamentu, an Atlantic Creole spoken in the Netherlands Antilles, St. Maarten, St. Eustatius, and Saba, through the use of experimental data focusing on tone and stress distinctions and their phonetic correlates. This paper expands initial descriptions of the tone and stress systems in Papiamentu (as it is spoken by an Aruban speaker) to include instrumental analysis of prosodic characteristics including numerical analysis of frequency and length in monosyllables and polysyllabic words.

KEYWORDS: *tone, stress, Papiamentu, pitch, duration, intonation, Aruba*

Introduction

Claire Lefebvre (2000: 131) wrote a column entitled “What do Creoles have to offer to mainstream linguistics?” She listed several linguistic fields to which the study of Creoles can contribute. Relevant to this study are her comments regarding language contact studies: “[Pidgin and Creole languages] derive their properties from their superstratum and substratum languages in a principled way [...] Pidgin and creole languages [...] instantiate extreme cases of contact between languages.” Papiamentu, an Atlantic Creole spoken in the Netherlands Antilles, St. Maarten, St. Eustatius, and Saba, demonstrates this

kind of contact in its phonological system which combines both stress and tone (Rivera-Castillo 1998).

In the investigation of the properties of Creole languages, comparative work with languages identified as their sources is unavoidable. Some research departs from the assumption that both the source and the genetically related language (Creole) belong, typologically, to the same family, which is a standard assumption in typological studies (Greenberg 1974; Joseph 1989), and that Creole languages resulted from a simplification of the lexifiers' systems (McWhorter 2000). Often the latter approaches tend to dismiss non Indo-European properties of Creoles as vestigial or marginal to the system (Hall 1966; Munteanu 1996). For these reasons, from the point of view of their phonology, the description of Atlantic Creoles has relied heavily on comparative studies with Indo-European languages. However, a comparison of Papiamentu's mixed tone and stress system with phonological systems in West African languages suggests that the Creole's suprasegmental structure is significantly closer to these systems than to those of intonational Romance languages.

In light of possible significant influences from the substrate systems, it is our position that the description of the tone and stress systems of Atlantic Creoles such as Papiamentu must precede any comparative study that relies primarily on data from intonational languages. This research supplements previous phonological descriptions of Papiamentu through the use of experimental data (from an Aruban speaker) focusing on tone and stress distinctions and their phonetic correlates.

The analysis expands previous descriptions of the interaction of tone and stress systems in Papiamentu to include instrumental analysis of aspects of the prosodic system. Pitch, duration, and amplitude measurements match the predictions outlined in phonological studies of Papiamentu (Harris 1951; Birmingham 1970; Römer 1980, 1983, 1991; Bendix 1983; Kouwenberg & Murray 1994; Rivera-Castillo 1998). The results of this pilot study provide evidence of a phonological system that combines stress from the lexifier and tone from the substrate through the systematic interaction of a set of phonetic correlates. For example, pitch represents tone, but it is higher in syllables that carry stress and H(igh) tone than in syllables with H tone only. As suggested by Lefebvre (2000), the study of the phonetic correlates of tone and stress in Creoles contributes to the study of all languages because Creoles incorporate features from different systems in a creative way.

Description of Papiamentu's Suprasegmental System

The classification of a language's suprasegmental system requires that its features match a subset of typological characteristics for pitch-accent, tonal, or/and stress languages (Hyman 1978 and 1992). According to previous work (Römer 1980, 1983, and 1991), Papiamentu's suprasegmental system does not fit into these prescribed categories since it has fully functional stress and tonal systems.

Other mixed systems exhibit an interaction between tone and stress. Rountree (1972: 312–313) states: "In Saramaccan, when there is no voice drop before a pause, the last syllable often receives stress and L(ow) tones are changed to either H or mid tone." However, in Saramaccan, stress has a more restricted role than in Papiamentu. In Saramaccan, usually only one syllable in each phrase carries stress. This is characteristically the penultimate syllable or the last syllable of a word preceding an unstressed monosyllable (Rountree 1972: 309). In Mandarin Chinese, contrastive stress raises H tone. However, utterance final stress assignment depends on whether the words and phrases in that position are made up of morphemes with falling tones (Yip 1980: 145). Therefore, stress is subordinated to tone. Cayuga (Northern Iroquian) has H tone and main stress that co-occur in some positions, but these have different status in the language (Goldsmith 1987: 67). Remijsen (2002) indicates that the Austronesian language Ma'ya also has lexically distinctive stress and tone. However, stress is not completely independent of tone. In early African American English stress and H-L and L-H tonal sequences have been recorded, but apparently tone patterns have no distinctive role in the language (Sutcliffe 2002). By contrast, in Papiamentu, both stress and tone have equal status at all levels.

At the phonological level, both stress and tonal systems in Papiamentu distinguish minimal pairs (including monosyllables for tone), play a role in morphological distinctions, and exhibit the characteristic features of these systems (Hyman 1978). For example, Papiamentu's stress system does not allow two positions with primary stress within the same word. In Papiamentu, stress is hierarchical, rhythmic, and demarcative of the word domain. This is the case in other stress systems (Kager 1995). Characteristics of the stress system are shown using example (1), given below (a single quotation mark for primary stress, double quotation marks for secondary stress, an acute accent for H tone, and L tone and unstressed syllables are left unmarked):

(1) "kumin'sá, 'begun'

Each word has one primary stress ('sa) that is placed by default in a fixed penultimate position (demarcative property). In polysyllabic words, secondary stress ('ku) applies. Stress is hierarchical given that there is only one primary stress. Stress phonotactics further requires an unstressed syllable (*min*) between a primary and a secondary stress (rhythmic property).

On the other hand, tonal distinctions in Papiamentu are determined paradigmatically.¹ Tone in Papiamentu can distinguish monosyllables (*é*, 'the' vs. *e*, 'he/she'). There are tonal patterns that distinguish lexical categories. The tonal system also exhibits a number of typical features such as tone spreading (2a), polarization (2b), contour tones (2c), tone preservation (2d), floating tones in utterance final positions (2e), and downdrift (Harris 1951; Römer 1991; Bendix 1983):

- (2a) $\begin{array}{ccccc} & H \emptyset & & \rightarrow & H H \text{ (Spreading Left to Right)} \\ \text{é} & \text{sáku} / \text{á} & \text{skér} & \rightarrow & \text{é} \text{ sákú} / \text{á skér} \\ \text{Det} & \text{N} & \text{Aux} & \text{V} & \\ & \text{'The bag tore.'} & & & \end{array}$

- (2b) $\begin{array}{ccccc} & \emptyset L & & \rightarrow & H L \text{ (Polarization Right to Left)} \\ \text{buníta} & \text{muchá} & \rightarrow & \text{bunítá} & \text{muchá} \\ \text{Adj} & \text{N-girl} & & & \\ & \text{'beautiful girl'} & & & \end{array}$

- (2c) $\begin{array}{c} H+L \\ \text{táflá'k, 'tablecloth'} \end{array}$

- (2d) $\begin{array}{c} \text{ta} \text{ dī} \text{ ámi e tá} \rightarrow \text{ta} \text{ dí} \text{m e tá} \\ \text{'This is mine.'} \end{array}$

- (2e) $\begin{array}{c} \text{lóko Wáncho} \text{ tá; na París Wáncho} \text{ tá} \\ \text{'W. is crazy; W. is in Paris.'} \end{array}$

¹ Restrictions in stress patterns are determined syntagmatically: (a) stress is relational because the particular degree of stress in a syllable depends on the relative stresses of adjacent syllables; and (b) stress is culminative because the differences in prominence between syllables result in a higher degree of stress in a particular position. The interpretation of tone height is possible without referring to tones in adjacent syllables. The same tone height can occur in several adjacent syllables. It can *spread* over more than one vowel, but stress never spreads over several syllables.

Spreading (2a) consists of a tone that doubles to an adjacent vowel (Goldsmith 1990: 29). Polarization (2b) or tonal polarity refers to a tonal alternation between H and L tones created by dissimilation during tone assignment to syllables unspecified for tone; for example, a L tone vowel immediately precedes a H tone vowel, and a H tone vowel immediately precedes a L tone vowel (Newman 1995: 771). Römer (1991) describes polarization in Papiamentu. Contour tones occur in bimoraic syllables, which are long (stressed) syllables carrying two different tones (2c). Tonal preservation and floating tones are tonal processes that apply to tones which are not associated to a vowel either because there has been a deletion of a vowel segment (2d), or because a tone is associated to a position such as a phrase final position within an utterance and this floating tone must attach to an available vowel at the end of a derivation (Goldsmith 1990: 20). This is the case of retorts and focus structures in Papiamentu (2e). Finally, downdrift describes the phonetic lowering of H tones due to the presence of a L tone in a phrase or utterance. This phonetic process is exemplified in the following section of the paper on the phonetic correlates of tone and stress.

The combination of the stress and tone systems in Papiamentu renders three categorical distinctions in disyllabic words (Rivera-Castillo 1998) (examples from Harris 1951: 9–10):

- (3) *ma'tá*, 'killed'-V part.
- (4) *'máta*, 'plant'-N
- (5) *'matá*, 'to kill'-V non-finite

Stress position distinguishes words with H tone in the last vowel [(3) vs. (5)]. H tone position distinguishes words with stress in the first syllable [(4) vs. (5)]. A fourth combination *má'ta* is not possible due to the fact that stress is penultimate by default, and a H tone in penultimate position exercises accentual attraction of stress. Evidence of this is found in derivational morphology. Stress *shifts* its position to the penultimate syllable when a H tone affix pronoun follows a verb: *'yuda + ábo* → *yu'dábu* (Römer 1980: 121; Agard 1985: 239).

In addition, certain combinations of stress and tone are attested for specific lexical categories. Some adjectives and nouns combine H tone and stress in the penultimate syllable (Harris 1951):

- (6) a'mígu 'máta 'hómbor pu'síbel
'friend' 'plant' 'man' 'possible'

Most Papiamentu verbs (7) and adverbs (8) carry stress in the penultimate syllable, and H tone in the last syllable (Goilo 1953: 139; DeBose 1975: 59):

- (7) 'drentá 'bisá 'duná
'enter' 'say, tell' 'give'
- (8) 'awé a'trobé
'today' 'again'

There are exceptions to these patterns, but most members of these categories conform to these. A summary of the general patterns of tone and stress interaction is given in Table 1 (Kouwenberg & Murray 1994; Maurer 1998).

Citation forms that result from these patterns, however, are further conditioned by phrasal level phenomena; for example, a stressed H tone syllable and utterance final H tones coincide in *kas* in (9), but not in (10) (Harris 1951: 35):

- (9) tur dia bo tá skuchá na 'kás
every day you Marker-habitual listen at home
'at home, you listen to X every day'

- (10) ún 'ká's tipiko arubiano
a house typical Aruban
'a typical Aruban house'

Table 1. *Patterns according to Kouwenberg & Murray (1994) and Maurer (1998)*

Lexical and Syllabic Class	Tone and Stress Patterns		
	Antepenult	Penult	Last
Disyllabic Verbs: ('matá)		stress	H tone
Past Participles: (ma'tá)*			H tone & stress
Polysyllabic Words: ('kumin'sá)	weak stress		H tone & stress
Nouns with heavy syllable: (ru'mán) [†]		L tone	H tone & stress
Nouns with final light syllable: ('máta)		H tone & stress	
Monosyllabic lexical items: ('ké)			H tone & stress

*Except for those ending in L tone or monosyllabic forms with a prefix *e-*

[†]Or nouns derived from verbs

In phrase internal position, an underlying H tone is realized as a tone contour, as shown in *ká's* in example (10). In fact, contour tones only occur in the last vowel of a word or in a monosyllable placed at the beginning of an utterance or phrase or in phrase internal position (Harris 1951: 35). In sentence final position, the H tone is subject to an additional floating H tone that results in a level H tone in *kás* in example (9).

Papiamentu exemplifies a system in which stress and tone are lexically distinctive. This is a rare phenomenon. In this sense, Creoles are ideal for the study of the typology of suprasegmental systems. These have reinterpreted features from many sources and have incorporated them into a coherent system such as the one exemplified by Papiamentu's tone and stress system (Rivera-Castillo 1998). This system includes stress from Indo-European languages and tone from West African languages. Additionally, tonal phenomena in Papiamentu differ significantly from that typical of pitch-accent systems, which have stress and tone. For example, polarization is a local phenomenon (based on adjacency) in Papiamentu, not a long distance one as it is typical of accent systems (Odden 1995: 468). On the other hand, in pitch-accent systems tone is culminative, such that only one H position occurs followed by L tones. Papiamentu has alternating H L or L H lexically determined tone patterns or similar alternations resulting from postlexical polarization, not a single H in accented positions. This is typologically a common kind of tonal system (Ratliff 1992).

Phonetic Correlates of Tone and Stress

Studies of stress in Spanish propose that pitch (as measured by fundamental frequency [F0]) and, to a lesser degree, duration constitute the acoustic cues for stress. Based on experimental work, Quilis (1988: 330–332) explains that the most important indication for the perception of stress in Spanish is the fundamental frequency, and length would be a secondary component. Debose (1975: 59) indicates that contrary to the Spanish system, “[i]n Papiamentu, tone height and vowel duration do not always co-occur,” and Römer (1980: 114) suggests that duration, rather than pitch, is the primary phonetic correlate of stress in Papiamentu. According to these analyses, stress in Papiamentu is signaled by duration and tone by pitch height. The phonetic correlate of pitch is fundamental frequency or F0 (Gandour 1978).

The study conducted by Remijsen (2002) on the phonetic correlates of tone and stress in Ma'ya reaches a similar conclusion.

Although the connection between phonological and phonetic categories is not a direct one, we propose that the relation is non-arbitrary and predictable. Before gathering the data, we predicted that F0 measurements would be higher when the vowel was specified for H tone, and this was corroborated by our analysis of the data. In addition, we predicted that syllables identified as *stressed* would exhibit longer duration measurements, and this was also confirmed.

Finally, we also investigated phonological analyses that predict the interaction of phrase level and word level phenomena associated with prominence: Before a phrase final position within an utterance (Harris 1951: 38), there is a slight rise or steady spreading of H tone from the last stressed position to the next vowel. For vowels with predetermined tones, there are no changes, but a vowel unspecified for tone changes before a phrase final position. Our data shows evidence that this applies to the last vowel of nouns (*sáku*) in phrase final position (see section *Tone Spreading and Polarization*).

Data Analysis

We prepared sixteen (16) carrier sentences (Ss), all constituting declarative statements, divided into three sets. Each set of Ss included stress and/or tonal distinctions.

In set A (Ss #1–#6), using the tone and stress distinctions in the minimal triplets *pis'ká*, *'piská*, *'píska*, we are testing differences in pitch and duration readings as correlates of phonologically predicted tone and stress position.

A. Minimal triplets: *pis'ká*, 'fish'-N / *'piská*, 'to fish'-V / *'píska*, 'fishing'-N

#1 mi tá du'nábó pis'ká
'I give you fish.'

#2 mi 'ké pis'ká
'I want fish.'

#3 mi 'ké 'piská
'I want to fish.'

- #4 esakí ta é pis'ká
'This is the fish.'
- #5 mi tá 'gustá 'píska
'I like fishing.'
- #6 mi tá 'gustá 'piská²
'I like to fish.'

Set B (Ss #7–#10) comprises sentences beginning or ending with LHL, and HHH tonal sequences originating in lexical patterns and postlexical polarization or spreading to test whether or not these show readings that differ from our predictions. Ss #7 and #9 should have a HHH sequence resulting from spreading of a H tone to the last syllable of *sáku*. S #8 should end in a LHL sequence due to polarization of *ta*, and S #10 has three lexically assigned H tones in a row:

B. Tonal sequences in different contexts: HHH / LHL

- #7 mi sáku tá marón (LHL beginning sentence)
'mi bag is brown.'
- #8 é sákú ta 'blánko (LHL utterance final)
'The bag is white.'
- #9 é sákú ta blánko (HHH beginning sentence)
'The bag is white.'
- #10 mi ké bís'ték (HHH utterance final)
'I want beef steak.'

Finally, set C (Ss #11–#16) includes sentences with H tone in different positions and syllables with different syllable onsets (vowels, voiced and voiceless

² The interviewer eliminated original Ss #6 and #7, and replaced them with Ss provided by the native speaker collaborator. The original Ss included a lexical item not present in the collaborator's native lexicon (dialectal distinctions).

consonants). In some languages, the type of onset in a syllable affects tone height (Hyman 2001).³

C. Different phonemes beginning syllable:

- #11 mi tá du'nábo 'pán
'I give you bread.'
- #12 mi tá du'nábo 'sálo
'I give you salt.'
- #13 mi tá du'nábó sal'móu
'I give you salmon.'
- #14 mi tá du'nábo 'léchi
'I give you milk.'
- #15 mi tá du'nábó a'róz
'I give you rice.'
- #16 mi tá du'nábo áwa
'I give you water.'

The speaker was an Aruban bilingual female in her twenties who has a college degree. The speaker, as a collaborator, helped in preparing the final version of the sentences. The sentences were recorded using a Telex unidirectional lapel microphone and a Sony Digital Audio Tape recorder in a quiet environment (the researcher's office). Recordings were transferred to a Kay Elemetrics Computerized Speech Laboratory (CSL) to make acoustic measurements. Three measurements were made for each syllable: duration, fundamental frequency (or pitch), and amplitude (or intensity). The waveform display, spectrograms, and audio playback were used to identify syllable boundaries. The pitch

³ Lehiste and Pavle (1978: 103) argue that voicing of initial consonants affects the realization of the F_0 curve in Serbo-Croatian. Also, features associated with a segment's melody usually determine a particular tonal pattern in other languages like Kanakuru (Chadic: Nigeria) (Odden 1995: 452): (a) like the HL pattern of verb stems beginning with a voiced obstruent (*bómblé*); or (b) the LH pattern of those beginning with a voiceless obstruent (*ta,klé*) (Odden 1995: 452). Kingston and Diehl (1994) provide evidence of the effect of contextual variation on the realization of distinctive features. They indicate that [...] "F0 is depressed next to [+voice] stops" [...] (1994: 425). To diminish the effect of consonant voicing on measurements, we compared segmentally identical words within different contexts. Further study of the effect of voicing in pitch measurements is necessary.

analysis and energy analysis functions of the CSL were used to calculate frequency and amplitude values.

Acoustic Analysis

The description of the interaction between phonetic correlates (as they are measured instrumentally) and phonological descriptions of stress and tone is a relatively new area of investigation. This is particularly true in the case of mixed tone and stress systems and the measurement of fundamental frequency (F0), or pitch values. Previous studies that have undertaken measurement of the F0 of vowel nuclei have employed different methods. In a study of downdrift in English intonation, Nolan (1995) measured F0 at the durational midpoint of each accented vowel. In a study of the phonetic interpretation of tone in Igbo, Liberman, Schultz, Hong, and Okeke (1993) measured the maximum value for H tones and the minimum value for L tones wherever these values appeared in the nucleus. Beckman (1986) engages in a detailed discussion of the potential problems inherent in measuring significant F0 value when the pitch is non-stationary, (i.e., when dealing with non-steady-state vowels). She reviews a number of issues that may affect vowel measurements such as perturbations of pitch connected to the preceding consonant (see also Kingston & Diehl 1994; Odden 1995), the effect of utterance level intonation patterns and other postlexical effects (see also Ladd 1996), and the effect of amplitude and duration on pitch movement.

Due to the way that the carrier sentences used for this study were constructed and also how they were read, the data set discussed here demonstrated a number of the postlexical effects listed above. These included perturbations of pitch movement due to utterance final pitch lowering (downdrift), list final pitch lowering, the use of a rising pitch or an extended fall-rise in pitch on the framing syllable immediately prior to the test words, and additional effects relating to immediately preceding consonants. For these reasons, rather than provide only a single F0 value for each syllable, we have provided raw F0 measurements taken from the beginning, middle and end of each vowel nucleus under consideration. In cases where the duration of the vowel nucleus approximated or was shorter than 50 ms, it was only possible to make two measurements. The three measurements displayed a

pitch pattern on the vowel nucleus that allowed us to more confidently assess postlexical pitch patterns on individual positions.

For measurements of duration, following Beckman (1986), syllable duration measurements included the voiced part of the vowel. Measurements were made within 5–10 ms using spectral cues. However, in utterances including unstressed tokens, the low intensity of these tokens made it more difficult to be precise regarding duration. Actual resolution is probably more like 20 ms in these cases (cf. Beckman 1986). In addition, in utterances in which nasals, laterals and approximants precede a vowel, the similar formant structures cause duration measurements to be less precise (Ladefoged 1982). Vowels preceded by nasals, liquids, and glides were not measured for duration, as the formant structure of the sonorant could not be as reliably separated from the vowel. Finally, phrasal phenomena may also affect duration measurements. For example, the first syllable exhibiting H tone in an utterance may carry additional length (Harris 1951: 42).

The description of the results of the measurements and their relation to phonological descriptions follows. The data agree with predicted lexical tone in all cases except where we can demonstrate that lexical tone is affected by phrasal phenomena.

Results

The results of the analysis are reported below. The findings have been divided into a series of sections for findings based on: (a) the correspondence between pitch measurements and predictions about tonal phenomena (*Pitch and Tone*); (b) disagreements between predictions of lexical patterns and measurements and their relation to spreading and polarization (*Tone Spreading and Polarization*); (c) the effects of phrasal phenomena on tone (*Sentence Level Phenomena and Tone*); (d) the correspondence between duration measurements and predictions about stress (*Stress and Duration*); and (e) disagreements between phonological predictions and duration measurements (*Other Stress Related Phenomena*).

Pitch and Tone

There are variations in readings throughout the vowel. However, H tone is clearly indicated throughout the data by higher F0 values. Therefore, the

Table 2. *Pitch measurements for tone in sentences #1–#6[†] (relevant vowels underlined)*

Sentences	Tone		
	High	Low	High
#1 mi ta du'náb <u>ó</u> p <u>is</u> 'ká	239-246-256	208-200-180	212-190-172
#2 mi 'ké p <u>is</u> 'ká	268-225-245	204-190*	212-204-180
#3 mi 'ké 'p <u>isk</u> á	239-216-256	225-212-193	225-190-172
#4 esaki ta <u>é</u> p <u>is</u> 'ká	208-212-204	200-180*	216-208-175
#6 mi ta 'gustá 'p <u>isk</u> á	225-234-245	208-200-190	234-225-190

*Short and unstressed

[†]Sentence #5 is not included here as this is HHL

distinctive role of tone is encoded with the corresponding phonetic distinction of F0. Examples can be seen in the set A measurements (Table 2).

Lexical differences in tone patterns are described in the section entitled *Description of Papiamentu Suprasegmental System* and in Table 1. Predicted differences between H tone syllables and following L tone syllables are attested in the data. For example, the noun *piská* in #1, #2, and #4 has a L H pattern reflected in the readings listed in Table 2.

Differences between H and L tones are perceptually salient.⁴ The last F0 reading in H tone syllables and the first F0 reading in L tone syllables have an average difference of 37.6 Hz in #1, #2, #3, #6, and #8 (for those above 20 Hz because of contextual similarities). The same readings show a perceptible but lower than 20 Hz difference in #4, #12, #13, #14, #15, and #16 (7.6 Hz average). In #12, #14, and #16, the L vowel is the last one in the sentence. In #4, the L tone vowel follows a H tone vowel within the same phrase (the determiner *é*). In #13 and #15, the L vowel is the first stressed vowel in a noun after the pronoun *bo*, whose tone is assigned postlexically. This shows a contrast with #1, where a syllable nucleus that follows *bo* is unstressed and has greater pitch differences with *bo* than those in #13 and

⁴ For frequencies below 1,000 Hz, the variation in frequency that we can detect as a change in pitch is about 2 or 3 Hz (Beckman 1986; Ladefoged 1996: 78). There are no absolutes for pitch height measurements for H tone syllables or L tone syllables. Pitch height is relative. It changes according to the vowel's position in the utterance, the speaker's gender, and due to co-articulation such that in a change from one tone to the next, there is a period of time during which the speaker has to make a transition from one pitch to the next (pitch delay and declination) [see Yip 2002]. We determined the correlation between pitch height and tone according to differences between adjacent syllables.

Table 3. *Pitch measurements for tone in sentences #7-#10 (relevant vowels underlined)*

Sentences	Vowel F0		
#7 mī sákú ta maron	184-175-172	225-216-225	245*
#8 e saku tá blánko	225-212-204	200-200-193	162-143*
#9 é sákú ta blanko	172-183-172	225-225-216	256-245*
#10 mī kē bísték	212-208-225	200-190*	212-204-186

*Short and/or underarticulated

Table 4. *Tone assignment due to polarization and H tone spreading from ná[†] to bō in Ss #11-#16*

Sentences	Vowel F0 and syllable position		
	bō	Penult	Last
#11 mī tá du'nábō 'pán	212-225-239		216-200-190
#12 mī tá du'nábō 'sálo	208-204*	216-204-200	193-180-167
#13 mī tá du'nábō sal'móu	212-225-212	204-193-190	190-180-167
#14 mī tá du'nábō 'léchi	216-212-208	204-208-204	190-167-151
#15 mī tá du'nábō a'róz	225-225-200	193-180-190	200-193-190
#16 mī tá du'nábō áwa	216-208-212	200-186-186	180-167-151

†ná always carries H tone and measurements are not included

*Short

#15. Despite these differences due to sentential position in which intonational effects or spreading apply, H tone syllables in #4, #12, #13, #14, #15, and #16 are acoustically salient. Readings for Ss #7-#16 precede in Tables 3, 4.

In addition, the combination of stress and tone affects pitch readings. In #10, there is a short unstressed vowel (*bī*) that has lower pitch readings than a vowel in sentence final position (*sték*) because the sentence ends in a sequence of H tones. The presence of stress and H tone in the last vowel (*sték*) explains why pitch is higher than in the vowel that only carries H tone. This is a result of accent (see section *Description of Papiamentu's Suprasegmental System*), which attracts tone and stress to one vowel and triggers higher pitch readings. The same effect is not evident in other vowels with H tone and stress because these are subject to downdrift due to the presence of a L tone. Additionally, stress by itself does not trigger higher pitch readings. Actually, it only has this effect in combination with a H tone if downdrift does not apply. Compare L tone stressed *pīs* (208-200-190) in #6 with the preceding unstressed H tone vowel *tá* (225-234-245), which is not

subject to the lowering effect of *pīs* (see discussion on downdrift in section *Sentence Level Phenomena and Tone*).

Tone Spreading and Polarization

L tone syllables (except for those turned H by spreading or polarization) always have F0 readings that go from higher to lower F0. There are exceptions due to polarization, which affects the marker *bo* in #1, #13, and #15, with readings that vary according to the following vowel. Other exceptions are due to spreading between H tones, which affects *ku* in #7 and #9, and *bo* in #11, #14, and #16. *Bo* is subject to polarization between different tones (L H or H L); and to spreading between H tones except in #12, where the vowel is unusually short (see Tables 3 and 4, above).

Measurements respond to predicted postlexical phenomena such as polarization and spreading. These show the effects of tone spreading between H tones to a vowel lexically undefined for tone (*bo*) or spreading to a following vowel (from *sā* to *ku* in #7 and #9) before phrase limits or pause (Noun Phrase). Not all vowels between H tones shift to H since some are lexically prespecified as L tone, and are not subject to change. For example, the vowels in *pīs* in Ss #1, #2, #3, #4, #6, in *sal* in #13, and *a* in #15 are noun initial and carry a lexically assigned L tone that does not change. Actually, Ss #15 and #16 show a contrast between a noun initial vowel prespecified as L tone (Figure 1 (S #15)) and one prespecified for H tone (Figure 2 (S #16)).

Figures reflect pitch contours for the utterance. This means that contours for complete syllables instead of only vowels are shown including differences between voiceless and voiced consonants, which have pitch readings that are not relevant to tone. Our measurements only reflect pitch readings for vowel nuclei. The relevant differences between *a* (L tone) in #15 and *á* (H tone) in #16 are, nevertheless, evident in the figures. Also, high pitch measurements of *bo* in #15 (polarization with *a*) and #16 (spreading between H tones) reflect the fact that this pronoun carries H tone in both cases. The dots over *bo* reflect these high pitch readings.

Finally, an additional characteristic of Papiamentu phonology is quantity sensitivity (Kouwenberg & Murray 1994: 12). F0 measurements indicate that syllables with a glide do not carry higher pitch (H tone), contrary to our predicted H tone (#13 in the carrier Ss list, above). The presence of a glide did not make the second syllable in the last noun in #13 a heavy syllable. This would have required that the vowel carry a H tone, as predicted by previous

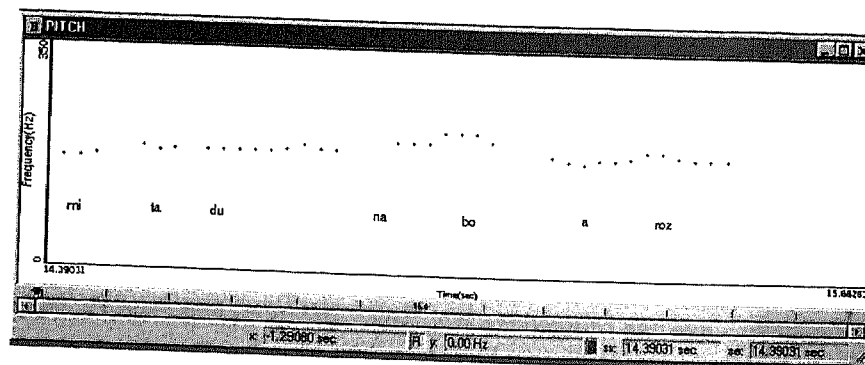


Fig. 1

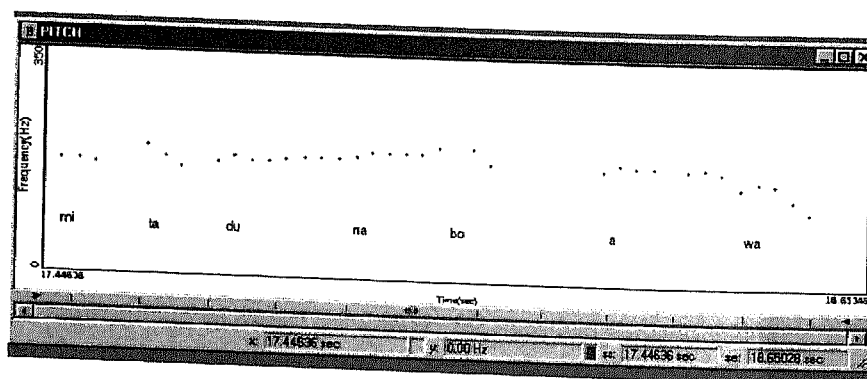
Sentence #15 du'nábó a'róz

Fig. 2

Sentence #16 du'nábo 'áwa

descriptions of lexical patterns (see Table 1, above, in the *Description of Papiamentu's Suprasegmental System* section). Glides, unlike consonants, do not attract H tone.

Sentence Level Phenomena and Tone

Besides postlexical polarization and spreading, there are numerous effects of sentence level phenomena on lexical tones. For example, syllables

associated with tones in utterance final or initial position carry context-determined tones. Questions have an utterance final H tone that applies to copular *ta* in that position. On the other hand, *lo* carries L tone at the beginning of an utterance or string, as expected in that position (Bendix 1983; Harris 1951: 40). The first tone in a sentence is always lower due to the superimposed intonational curve. According to Harris (1951: 40), stressed syllables at the beginning of a phrase have L tone.

Pitch readings in our sentences provide an example of the latter phenomenon. Based on lexical tones and tone spreading in the noun, we expected a HHH sequence at the beginning of S #9. However, pitch readings indicate that there is a LHH sequence:

	172-183-172	225-225-216	256-245	
#9	é	sá	kú	ta blánko

Figure 3 shows this with a low fundamental frequency on é followed by a steep rise in pitch on the following two syllables (*sá kú*).

Additional sentential phenomena that might be related to data collection shows up in Ss #1, #2, #3, #13 and #16. This is related to the speaker's style in reading the sentences. For example, the vowel before the utterance final word (*bo* and *ke*) has a higher F0 measurement, or what seems to reflect a rising intonation pattern, as the speaker uses this syllable as a frame to announce the final noun or verb. Also, in sentence #6, the rising intonation

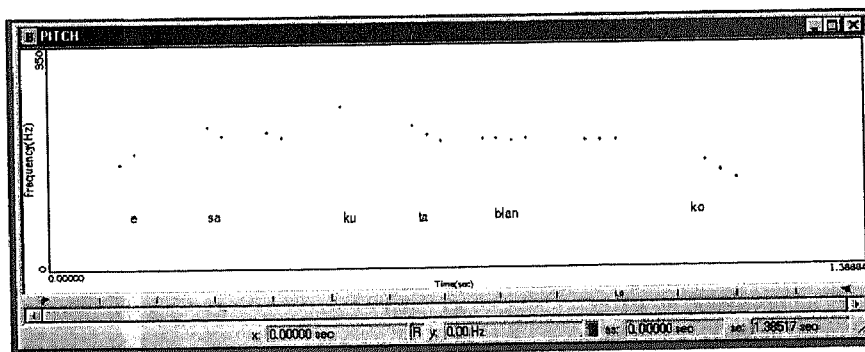


Fig. 3

Sentence #9 é 'sákú ta 'blánko

on *gusta* is accompanied by a slight pause. Harris (1951: 37) indicates that a phrase in the middle of an utterance can end in a mid tone rather than a L tone. This indicates that the phrase carries a phrasal H tone.

Downdrift also affects tone levels. Except in #10 (ending in HHH), vowel F0 measurements of H tone syllables in sentence final position are lower than in preceding H tone syllables (Ss #1, #2, #3, #4, #6, #11, #13, and #15). The presence of a HHH sequence suppresses downdrift in #10. In S #3, *pis* (L tone) has higher pitch readings than the following H tone vowel. This, however, indicates one of the effects of downdrift since the H tone vowel *ké* (in Table 2) preceding *pis* in Ss #2 and #3 is significantly higher than any of the following syllables. In addition, in sentence #16, which ends in a L tone, there is evidence of a *list-final* intonation pattern.

Stress and Duration

Phonologically assigned stress corresponds to longer duration. Exceptions have clear distribution throughout the data. Measurements for the last three syllables in our Ss #1–#6 follow in Table 5.

For the first six Ss, we measured the whole syllable *pis* from the closure and release burst to the end of the /s/. *ka* measurements include the closure (which is identifiable following the /s/), the release burst, and the voiced part of the vowel. Stressed syllables are twice as long as unstressed syllables in the same position. Compare unstressed *pis* in #1, #2, and #4 (49.3 ms average) vs. stressed *pis* in #3, #6 (100 ms average).

Sentence final syllables are longer than adjacent syllables (except in #6) and could be about the same length of a preceding stressed syllable. This results from postlexical syllable lengthening.

Table 5. *Duration measurements and predictions about stress for Ss #1–#6 (relevant syllables underlined)*

Sentences	Syllable Duration (ms)		
	Preceding	<i>pis</i>	<i>ka</i>
#1 mi ta du'nábó <u>pis'</u> ká	88	59	117
#2 mi 'ké <u>pis'</u> ká	151	48	118
#3 mi 'ké 'piská	169	95	114
#4 esaki ta é <u>pis'</u> ká	91	41	134
#5 mi tá 'gustá 'píska	56	51	115
#6 mi ta 'gustá 'piská	97	105	100

Other Stress Related Phenomena

With the exception of utterance final lengthening, phonological stress placement corresponds to longer syllable duration. There are clear differences in duration of *pis* in #2 and #3, in which there is different stress placement in the same sentential template (#2: *pis'ka*; #3: *'piska*). On the other hand, Römer's (1980: 114) initial analysis of Papiamentu's suprasegmentals predicts a shorter duration of the first syllable of the verb in #3 (*'piska* – 95 ms) compared to the duration of the second syllable in the noun in #2 (*pis'ka* – 118 ms) even when both are stressed. These differences arise in part from longer duration of syllables in utterance final position. However, that does not explain significant differences in duration, which are independent of syllable position (Rivera-Castillo 1998). Final syllables with stress and H tone are longer than final syllables with stress only. In sentences #1–#6, duration of sentence final stressed H tone syllables is 123 ms average, and stressed syllables are 107 ms average. According to Lehiste and Pavle (1978: 102) accented syllables are longer than unaccented ones in a proportion of 3:2 in many languages, which helps to explain these differences. In other sentences, duration measurements indicate the same differences (Table 6).

Despite the sentence final lengthening effect, penultimate stressed and H tone syllables in #8, #12, #14, and #16 are consistently longer than the last syllable. Although #16 might be subject to differences in measurements due to the presence of a /w/, all other cases show longer penultimate syllables. In fact, the average duration of penultimate stressed and H tone syllables in these sentences is 127 ms, while the average for stressed and H tone syllables in final position is 113.25 ms.

Table 6. *Duration measurements for Ss #8, #10–#16 (relevant syllables underlined)*

Sentences	Syllable Duration (ms)		
	Preceding	Penultimate	Last
#8 é sákú ta <u>'blánko</u>	57	94	63
#10 mi <u>ké</u> <u>bís'ték</u>	129	41	87
#11 mi tá du'nábo <u>'pán</u>	126	52	92
#12 mi tá du'nábo <u>'sálo</u>	39	175	142
#13 mi tá du'nábo <u>sal'móu</u>	61	94	141
#14 mi tá du'nábo <u>'léchi</u>	78	114	102
#15 mi tá du'nábo <u>a'róz</u>	85	123	133
#16 mi tá du'nábo <u>'áwa</u>	69	189	88

Experimental data must consistently indicate increased duration and intensity for stressed syllables. The results discussed above have focused on the phonetic correlates of tone and stress through the investigation of measurements of fundamental frequency and duration. Additional measurements of amplitude should reveal more information about tonal and stress distinctions. During this study, amplitude was measured by taking the highest peak of amplitude for each syllable (Shunde 1996). However, we believe that an alternative method of computing amplitude may be more effective, such as taking measurements throughout the syllable at 10 ms intervals (Beckman 1986). For this reason, amplitude will be re-analyzed before any further analysis is undertaken.

Conclusions

Given that Papiamentu combines different phonological means and phonetic correlates to signal prominence, this analysis suggests a method to evaluate hypotheses regarding the connection between phonetics and phonology in this language. It also tests the accuracy of phonological descriptions regarding language production. The evidence provided by the phonetic data supports a description of Papiamentu as a tonal language. Pitch readings indicate the presence of tonal polarity, tone spreading before phrase internal limits, downdrift and the interaction between lexical tone and phrase level pitch patterning.

There is also evidence that stress in Papiamentu is signaled using the phonetic correlate of duration. Amplitude may play a role, and this will be investigated in future studies. In those cases where pitch played an additional role in signaling stress, it was demonstrated that it only applied in combination with a H tone (accent) and in cases with no downdrift effects.

More research of these phenomena is necessary. Most particularly, an expansion of the data set to include Papiamentu speakers who reside permanently in the Antilles. Only one multilingual speaker participated in the collection of this particular set of data and since English was her day to day language at the time we recorded her, we are unclear to what extent English intonational patterns were superimposed upon her own. Despite this reservation, the data on *lexical tone and stress* were consistent with previous phonological descriptions of tone and stress in this language.

Experimental work on Papiamentu's suprasegmental properties has great relevance for language typology, historical linguistics, and the understanding of properties of human languages. Work on the structure of Creoles in particular, is of the utmost importance as has been indicated by Singh and Myusken (1995) in a column published in the *Journal of Pidgin and Creole Languages*. Relevant discussion has arisen during recent conferences, such as the 2002 Creole Phonology and Morphology conference, organized by Ingo Plag. Along these lines, the study of Creole languages in general is of utmost importance.

We are currently following up this pilot work on Aruban Papiamentu with work on Curaçaoan Papiamentu. A new set of data has already been collected which includes a broader selection of informants and a more comprehensive data set. Other researchers, such as Remijsen (personal communication), have new data on Curaçaoan Papiamentu that we do not include in this study since his analysis is not complete. As we investigate how the phonetic correlates work in this language, we continue to refine our measurement criteria as our work with new data progresses.

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References

- Agard, F. B. (1985). Papiamentu grammars and the structure of the language. In V. Z. Acson and R. L. Leed (Eds.), *Oceanic linguistics special publication*, No. 20 (pp. 235–242). Honolulu: University of Hawaii Press.
- Archangeli, D., & D. Pulleyblank (1994). *Grounded phonology*. Cambridge, MA: The MIT Press.
- Beckman, M. (1986). *Stress and non-stress accent*. Dordrecht: Foris Publications.

- Bendix, E. H. (1983). Sandhi phenomena in Papiamentu, other creoles and African languages: Can they be used to reconstruct history? In L. D. Carrington (Ed.), *Studies in Caribbean language* (pp. 112–123). Saint Augustine, Trinidad: University of West Indies.
- Birmingham, J. C., Jr. (1970). The Papiamentu language of Curaçao. University of Virginia dissertation.
- DeBose, C. E. (1975). Papiamentu: A Spanish-based creole. Stanford University dissertation.
- Gandour, J. T. (1978). The perception of tone. In V. A. Fromkin (Ed.), *Tone: A linguistic survey* (pp. 41–76). New York: Academic Press.
- Goilo, E. R. (1953). *Gramatica Papiamentu*. Curaçao: Hollandsche Boekhandel.
- Goldsmith, J. A. (1987). The rise of rhythmic structure in Bantu. *Phonologica 1984: Proceedings of the Fifth International Phonology Meeting*, 65–78.
- Goldsmith, J. A. (1990). *Autosegmental and metrical phonology*. Oxford, England: Basil Blackwell.
- Greenberg, J. (1974). *Language typology: A historical and analytic overview*. The Hague/Paris: Mouton.
- Hall, R. A. (1966). *Pidgin and creole languages*. Ithaca, NY: Cornell UP.
- Harris, C. C. (1951). Papiamentu Phonology. Cornell University dissertation.
- Hyman, L. M. (1978). Tone and/or accent. In D. J. Napoli (Ed.), *Elements of tone, stress, and intonation* (pp. 1–20). Washington, DC: Georgetown University Press.
- Hyman, L. M. (1992). Tone in phonology. In W. Bright (Ed.), *International encyclopedia of linguistics*, Vol. 4 (pp. 165–167). New York: Oxford University Press.
- Hyman, L. M. (2001). Privative tone in Bantu. In Shigeki Kaji (Ed.), *Cross-linguistic studies of tonal phenomena: Tonogenesis, Japanese accentology, and other topics* (pp. 237–257). Tokyo: Institute for the Study of Languages and Cultures of Asia and Africa.
- Joseph, J. E. (1989). Typology, diachrony, and explanatory order. *Diachronica*, 6 (1), 55–74.
- Kager, R. (1995). The metrical theory of word stress. In J. A. Goldsmith (Ed.), *The handbook of phonological theory* (pp. 367–402). Cambridge, MA: Blackwell.
- Kingston, J., & R. L. Diehl (1994). Phonetic knowledge. *Language*, 70, 3, 419–454.

- Kouwenberg, S., & E. Murray (1994). Papiamentu. *Languages of the world/materials* 83. München/Newcastle: Lincom Europa.
- Ladd, R. D. (1996). *Intonational phonology*. Cambridge: Cambridge University Press.
- Ladefoged, P. (1982). *A course in phonetics*. San Diego: Harcourt Brace Jovanovich Publishers.
- Ladefoged, P. (1996). *Elements of acoustic phonetics* (2nd edition). Chicago and London: The Chicago Press.
- Lefebvre, C. (2000). What do creole studies have to offer to mainstream linguistics? *Journal of pidgin and creole languages*, 15 (1), 1–35.
- Lehiste, I., & I. Pavle (1978). In D. J. Napoli (Ed.), *Interrelationship between word tone and sentence intonation in Serbo-Croatian. Elements of tone, stress, and intonation* (pp. 100–128). Washington, DC: Georgetown University Press.
- Lieberman, M., I. M. Schultz, S. Hong, & V. Okeke (1993). The phonetic interpretation of tone in Igbo. *Phonetica*, 50, 147–160.
- Maurer, P. (1998). El papiamentu de Curaçao. In M. Perl and A. Schwegler (Eds.), *América negra: Panorámica actual de los estudios lingüísticos sobre variedades hispanas. Portuguesas y criollas* (pp. 139–217). Frankfurt/Madrid: Vervuert/Iberoamericana.
- McWhorter, J. H. (2000). *The missing Spanish creoles*. Berkeley/Los Angeles/London: University of California Press.
- Meeussen, A. E. (1970). Tone typologies for West African languages. *African Language Studies*, 11, 266–271.
- Muntenau, D. (1996). *El papiamentu, lengua criolla hispánica*. Madrid: Editorial Gredos.
- Nespor, M., & I. Vogel (1986). *Prosodic phonology*. Dordrecht-Holland/Riverton-USA: Foris Publications.
- Newman, P. (1995). Hausa tonology: Complexities in an ‘easy’ tone language. In J. A. Goldsmith (Ed.), *The Handbook of Phonological Theory* (pp. 762–781). Cambridge, MA: Blackwell.
- Nolan, F. (1995). The effect of emphasis on declination in English intonation. In J. Windsor-Lewis (Ed.), *Studies in General and English Phonetics* (pp. 241–254).
- Odden, D. (1995). Tone: African languages. In J. A. Goldsmith (Ed.), *The handbook of phonological theory* (pp. 444–475). Cambridge, MA: Blackwell.

- Quilis, A. (1988). *Fonética acústica de la lengua española*. Madrid: Editorial Gredos.
- Ratliff, M. (1992). Form and function in tone languages. In L. A. Buszard-Welcher, J. Evans, D. Peterson, L. Wee, and W. Weigel (Eds.), *Proceedings of the 18th Annual Meeting of the Berkeley Linguistics Society – Special Session on the Typology of Tone Languages* (pp. 134–144). Berkeley: University of California Press.
- Remijsen, B. (2002). Lexically contrastive stress accent and lexical tone in Ma'ya. In C. Gussehoven and N. Warner (Eds.), *Laboratory Phonology VII* (forthcoming). Berlin/New York: Mouton de Gruyter.
- Rivera-Castillo, Y. (1998). Tone and stress in Papiamentu: The contribution of a constraint-based analysis to the problem of Creole genesis. *Journal of pidgin and creole languages*, 13 (2), 1–38.
- Römer, R. G. (1980). Proclisis y enclisis en una lengua tonal. *Diálogos hispánicos de Amsterdam*, 1, 113–123.
- Römer, R. G. (1983). Papiamentu tones. In E. Muller (Ed.), *Papiamentu: Problems and possibilities, papers presented at the Conference on Papiamentu on the occasion of the 65th anniversary of Madero & Curiels Bank* (pp. 85–96). Zutphen: De Walburg Pers.
- Römer, R. G. (1991). *Studies in Papiamentu phonology*. Amsterdam and Kingston: The University of Amsterdam.
- Rountree, C. S. (1972). Saramaccan tone in relation to intonation and grammar. *Lingua*, 29, 308–325.
- Shunde, J. (1996). An Acoustic Study of Sentence Stress in Mandarin Chinese. Ohio State University dissertation.
- Singh, R., & P. Myusken (1995). Wanted: A debate in Pidgin/Creole phonology. *Journal of pidgin and creole languages*, 101, 157–170.
- Sutcliffe, D. (2002). African American English supersegmentals: A study of pitch patterns in the Black English of the United States. In Ingo Plag (Ed.), *2002 Creole Phonology and Morphology Conference* (forthcoming).
- Yip, M. J. W. (1980). The tonal phonology of Chinese. MIT dissertation, MIT Working Papers in Linguistics.
- Yip, M. (2002). *Tone*. Cambridge, UK: Cambridge University Press.

ECHOES OF AFRICA: REDUPLICATION IN CARIBBEAN CREOLE AND NIGER-CONGO LANGUAGES¹

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This paper considers whether specific reduplication processes in the English-lexified Creole languages of Jamaica and Suriname are due to substrate transfer by exploring the extent to which their formal, functional and selectional characteristics in those languages can be related to Niger-Congo (NC). The issue is discussed in the context of a theory of markedness and we propose that formal and semantic iconicity are among the criteria for evaluating markedness in reduplication. According to markedness criteria, we identify deverbal noun reduplication and deverbal attribute formation, as they occur in Jamaican and the Suriname Creoles, and Jamaican X-like reduplication, as marked processes. Assuming that marked processes provide better evidence for substrate transfer, we searched for parallels for these specific processes in likely NC source languages. The best evidence for substrate transfer is found in stative adjective reduplication in the Suriname Creole languages, which finds a parallel in Gbe. The evidence for transfer from Gbe in the deverbal adjectives

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