UCLA Working Papers in Phonetics, No.111 (2012), pp. 63-91

The Intonation of Tongan

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Abstract

This paper presents a model of the intonational system of Tongan, an Austronesian language, taking the autosegmental-metrical theory as its framework. Tongan has lexical stress which appears on the penultimate syllable of prosodic words and is marked post-lexically with one of two bitonal pitch accents—a rise, LH*, or a low tone, L*. Measurements show that the first tone of both pitch accents aligns with the stressed syllable onset, while the second tone aligns with the stressed syllable offset. There is evidence for two tonally marked levels of prosodic phrasing in Tongan, the intonational phrase (IP) and the accentual phrase (AP). The IP is about the size of a full utterance or major phrase and is marked by a final boundary tone and are realized on the IP-final syllable. Four boundary tones have been observed. The smaller unit, the AP, usually contains one lexical word plus preceding functional elements. Two AP-final tones have been observed, realized on the final syllable of the phrase. Lastly, focus is only realized intonationally through increased pitch range on the focused element. Tongan is typologically interesting because it provides another case in a growing list of languages that intonationally marks both head and edge prominence.

1. Introduction

1.1 Language Background

Tongan is a Malayo-Polynesian language with approximately 126,390 speakers and is a national language spoken in Tonga (Lewis, 2009).

Tongan is an ergative/absolutive language, in which the subject of a transitive verb is marked by an ergative case *ʻe* (here and throughout, apostrophe refers to glottal stop) and the transitive object and intransitive subject are marked by an absolutive case *ʻa*. The default word order in Tongan is VSO yet Tongan permits alternative VOS order, as shown in (1a) and (1b).

(1) a. *naʻe kaukauʻi ʻe manu ʻa mele*
PST bath-TRAN ERG Manu ABS Mele
'Manu was bathing Mele.'
b. *naʻe kaukauʻi ʻa mele ʻe manu*
PST bath-TRAN ABS Mele ERG Manu
'Manu was bathing Mele.'

1.2 Stress Pattern

Tongan has lexical stress. Primary stress is completely predictable and falls on the penultimate vowel in each lexical word. Earlier analyses have offered the following exceptions to this rule (Churchward, 1953; Feldman, 1978): (a) when the last vowel is long (i.e. quantitive-sensitive), (b) when the word is followed by an enclitic, such as the article *-e* , person markers, conjunction *pea*, deictic suffixes, *ni/na* (e.g. when *-ne*, a pronoun enclitic, attaches to *'oku* (present tense), the stress falls on *ku* rather than *'o* because the prosodic word is *'oku-ne*), and (c) definite accent.

However, later analyses (e.g. Schutz 2001, Anderson & Otsuka 2006) have been able to eliminate two of these exceptions. Stress in Tongan falls on the penultimate mora, where single vowels consist of one mora and so-called long vowels (which are perhaps best considered to be two single vowels in a row) consist of two morae. The definite accent (see below) is no longer considered to be a stress shift, but rather a reduplicative suffix, which copies the final vowel of the word and causes a stress shift due to the renumbering of morae. The remaining exception to penultimate stress assignment is when a word is followed by an enclitic, which we discuss in Section 3.2.1.

Primary stress in Tongan is acoustically manifested with longer duration, greater intensity and different voice quality than unstressed vowels (Garellek & White, 2012). Stress is marked post-lexically with a pitch accent, thus, higher average pitch also serves to differentiate stressed from unstressed vowels.

1.3 Definitive Accent (DA)

Unlike most Polynesian languages, Tongan has an unusual phenomenon called 'definitive accent'. Definite accent involves an apparent rightward stress shift from the penult vowel to the last vowel in a prosodic word when the noun phrase is definite. Clark (1974) argued that definitive accent is derived from a Proto-Polynesian deictic suffix, **-e*. (2) is a minimal pair with definitive accent and the primary stress is expressed by the grave accent on the top of the vowel. *e* is a referential article, and whether the noun is definite or not is determined by the appearance of the definite accent. Therefore, Anderson & Otsuka (2006) stated that "definiteness is indicated not by means of articles, but appears to be indicated phonologically."

(2) a. *ko e me'aléle* 'It is a car.'
b. *ko e me'alelé* 'It is the car.'

In fact, definitive accent applies to a whole DP, realized on the last word of DP, whether the word is noun or not. In structures such as relative clauses which have a CP embedded in the DP, the definite accent is realized on the last word of CP, as shown in (2c) and (2d).

(3) a. *ko* [$_{DP}$ *e mastati engeengá*]
'It is the yellow mustard.'
b. *ko* [$_{DP}$ *e mastati engeenga 'a mananá*].
'It is Manana's yellow mustard.'
c. *ko* [$_{DP}$ *e mastati engeenga* [$_{CP}$ *na'e fakatau 'e mananá*]]
'It is the yellow mustard Manana bought.'
d. *ko* [$_{DP}$ *e mastati engeenga* [$_{CP}$ *na'e fakatau 'e manana 'i he pongipongí*]]
'It is the yellow mustard that Manana bought yesterday'

The appearance of definitive accent influences the interpretation of a sentence. For instance, the only difference between (3a) and (3b) is the location of the definitive accent. The two sentences have different interpretations though the difference is trivial.

(4) a. *na'a-ne 'alu ki he fakatahá 'aneafi?*
PST-3rd.sg. go to ref meeting yesterday
'Did he go to the meeting yesterday?'
b. *na'a-ne 'alu ki he fakataha 'aneafí?*
PST-3rd.sg. go to ref meeting yesterday
'Did he go to yesterday's meeting?'

The phonetic cue for a definitive accent is mainly durational – a vowel receiving definite accent will appear twice as long as normal. This is because the definite accent is a reduplicative suffix, which copies the final mora of the word (Anderson & Otsuka, 2006). Thus, a vowel receiving definite accent will last for two morae instead of one. There is no special pitch movement associated with the definite accent, therefore we provide no unique labeling for it in this study.

2. Method

The present study is based on a corpus of data collected from two native speakers of Tongan, one male and one female. Both speakers are also speakers of English as a second language. Speakers were typically recorded using a head-mounted microphone in separate sessions in a quiet room or in a sound-attenuated booth, though we also examined recordings made in the class room and recordings made using laptop-internal and cell-phone microphones.

Recordings were segmented and labeled, and pitch tracks were examined using PRAAT. Pitch tracks were analyzed by locating the peaks or valleys in each utterance.

3. Model

We propose that Tongan is both a head- and edge-prominence marking language. We have found evidence for the most common pitch accent LH*, where L is anchored to the beginning of the onset consonant and H is anchored to the offset of the stressed mora. And L* is the other pitch accent which only appears on the last stressed mora at the end of a sentence . We have as well found two levels of prosodic phrasing: the Intonational Phrase (IP) and the Accentual Phrase (AP). For the AP, we propose the following edge tones: a high tone, Ha, and a low tone, La. For the IP, we propose the following boundary tones: a high tone, H%, an upstepped high tone, ^H%, a low tone, L%, and a rising tone, LH%. Figure 1 provides a schematic of the proposed model. More than one pitch accent may occur within an AP, and more than one AP may appear in an IP. IP-final boundary tones override AP-final tones; they do not combine to form contours.

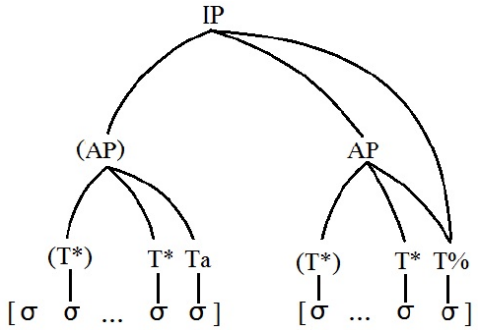

FIGURE 1. A schematic diagram of the proposed model of Tongan intonation. Word boundaries are indicated with square brackets. Pitch accents are marked with T*, and the Accentual Phrases (AP) are marked on the right edge with an edge tone, Ta. Intonational Phrases (IP) contain one or more APs and are marked on the right edge with a boundary tone, T%, which overrides the lower AP edge tone.

In the following sections, we will describe the pitch accents (i.e. LH* and L*) and boundary tones (i.e. La, Ha, L%, H%, ^H% and LH%) in detail.

3.1 Pitch Accents

3.1.1 The Full Rise LH*

The rising pitch accent, which we propose to label as LH*, is by far the most common pitch accent type in Tongan. It is the only pitch accent that appears IP-medially, and it can appear on both primary and secondary stress. Figure 2 illustrates the LH* accent on a word in isolation and Figure 3 shows several repetitions of the accent in a longer sentence.

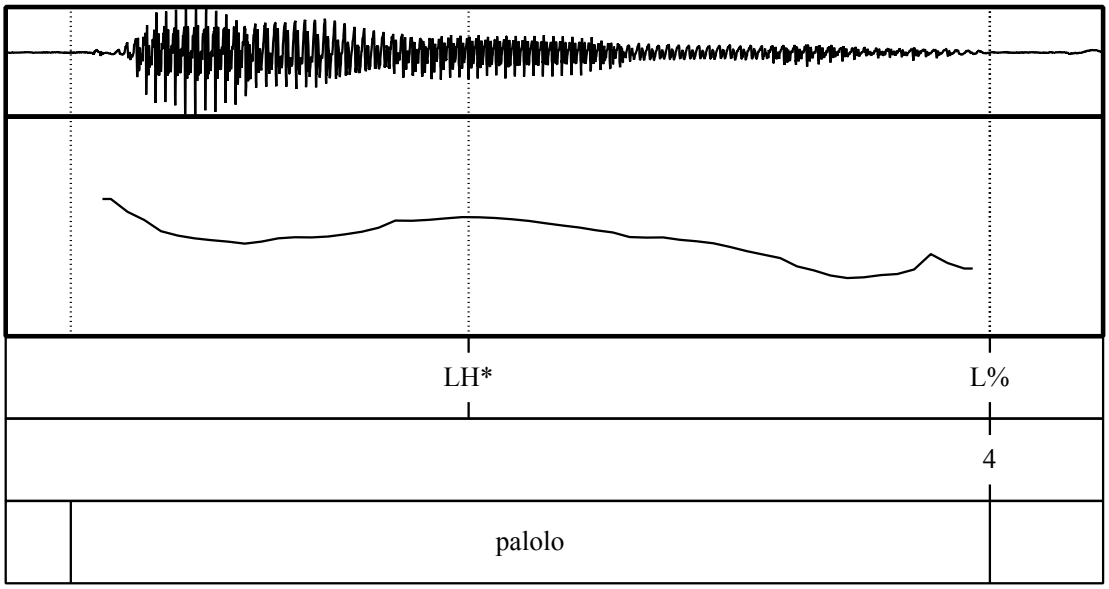

FIGURE 2. Pitch track of the word *palolo*, "sea worm," spoken in isolation. A LH* pitch accent marks the stressed penultimate mora.

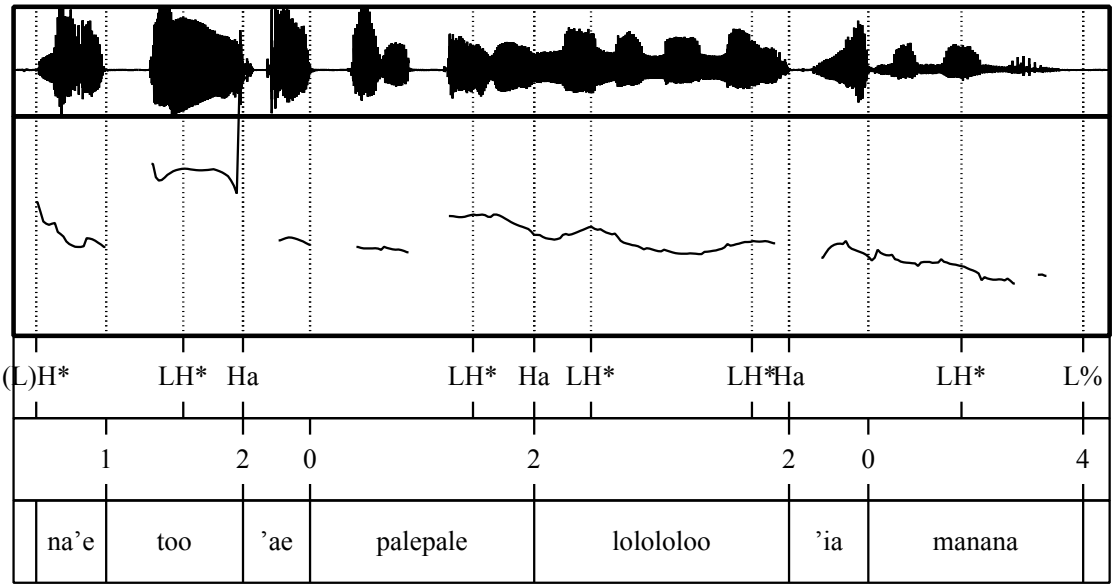

FIGURE 3. Pitch track of the sentence, "The oily porch covering fell on Manana." A LH* pitch accent appears on the stressed penultimate mora of each IP-medial AP, and on the secondary stress in *lolololoo*, "oily."

na'e	*too*	*'ae*	*palepale*	*lolololoo*	*'ia*	*manana*
PST	fall	ABS.E	porch covering	oily.DA	on	Manana

As can be seen from Figures 2 and 3, the LH* pitch accent is realized with a low target near the onset of the stressed syllable and a high target near the end of the stressed mora. In order to get a clearer picture of the alignment of this pitch accent, we conducted a small, pilot experiment. Several words were recorded embedded in a sentence such that they would receive the rising pitch accent. Each word was recorded a few times. Only recordings from our female consultant were analyzed. Several segmental environments surrounding the stressed mora were examined: VSV SV, VSV OV, VOV SV, VOV OV, VSV V, and VV SV, where S is a sonorant consonant and O is an obstruent consonant. Pitch was measured using the Straight algorithm in VoiceSauce (Shue et al. 2011). Ten equally spaced measurements were made for each segment, allowing pitch tracks to be normalized across varying segmental durations.

Figure 4 shows the VSV SV condition. We found that the low target of the rise does indeed align with the onset of the stressed syllable – pitch falls over preceding segmental material until the beginning of the sonorant onset consonant. The high target aligns with the offset of the stressed vowel. Because the entire rise occurs on the stressed syllable, we choose the label LH* over alternatives such as L+H*, which would indicate the low and high targets appear on different syllables.

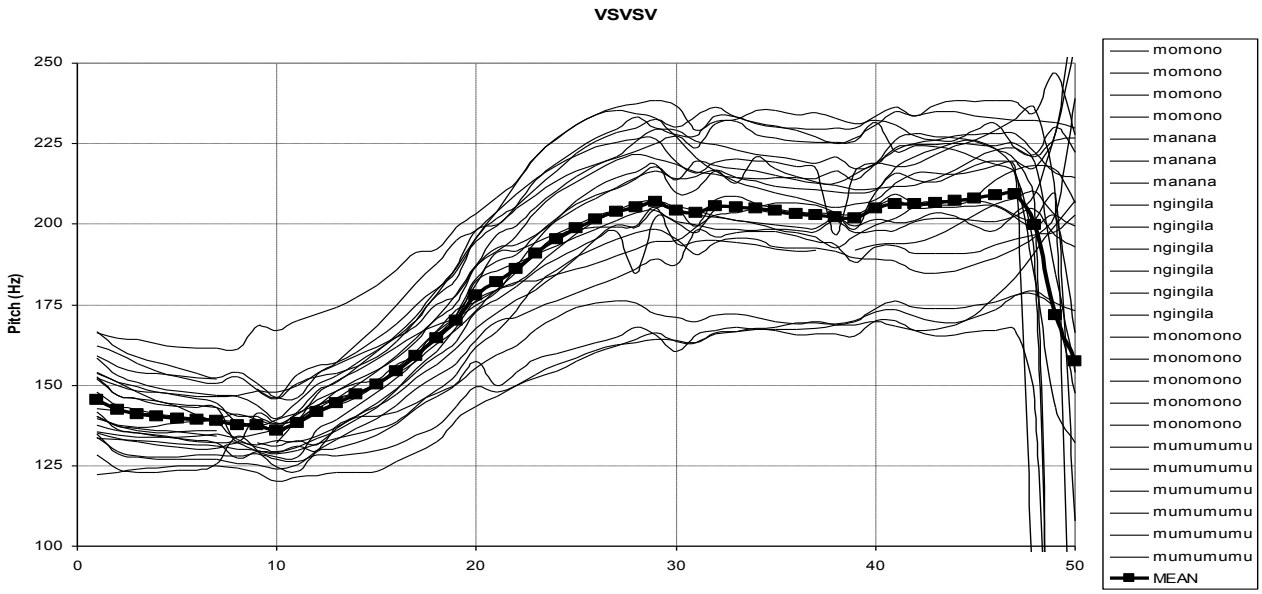

FIGURE 4. Normalized alignment data from VSV SV sequences accented with a LH*. Ten measurements were made for each segment, so each vertical grid line indicates a segment boundary. The pitch tracks of each individual token are shown, and the mean pitch track is illustrated with a darker line with square points. The low target of the LH* aligns with the stressed syllable onset, at point 10, and the high target aligns with the stressed vowel offset, at point 30.

This alignment can appear to be shifted due to microprosodic effects from surrounding obstruents. Figures 5, 6 and 7 show alignment data for the LH* accent in VSV OV, VOV SV, and VOV OV contexts. Like in English (Lehiste 1970), the pitch following a voiceless obstruent is higher than pitch following a voiced sonorant (Tongan only has one voiced obstruent, [v]). Pitch preceding a voiceless obstruent is lower than pitch preceding a voiced segment.

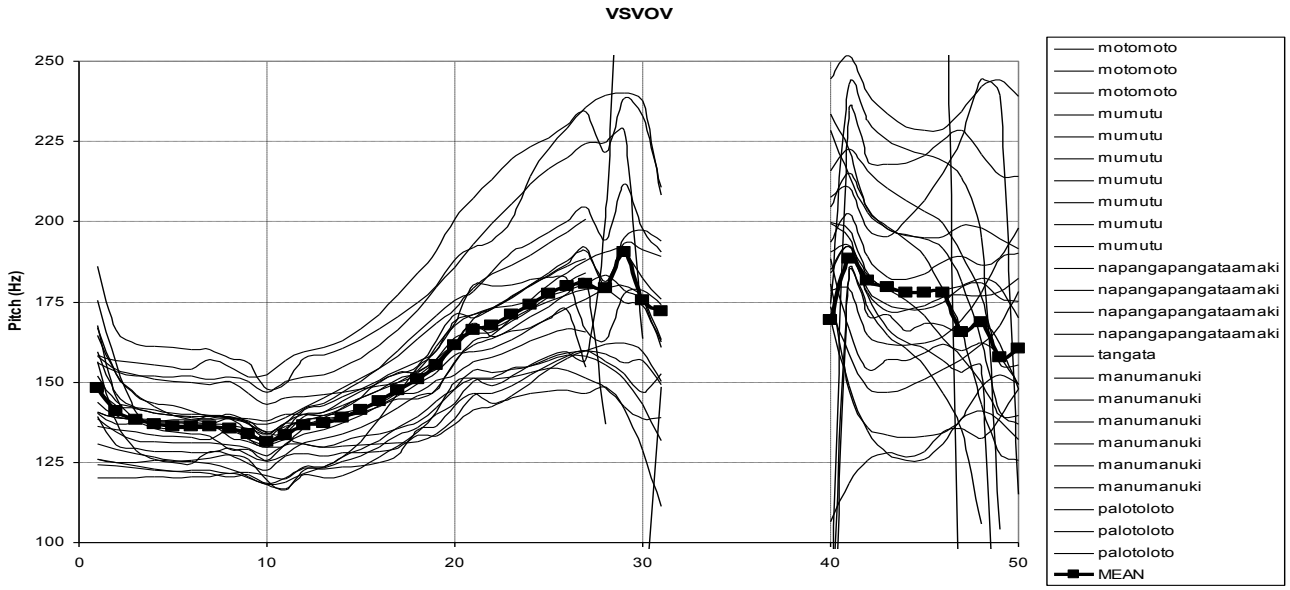

FIGURE 5. Normalized alignment data from VSV OV sequences accented with a LH*. Due to microprosodic effects, the high target aligns with the middle of the stressed vowel, around point 25. Pitch then falls into the following obstruent.

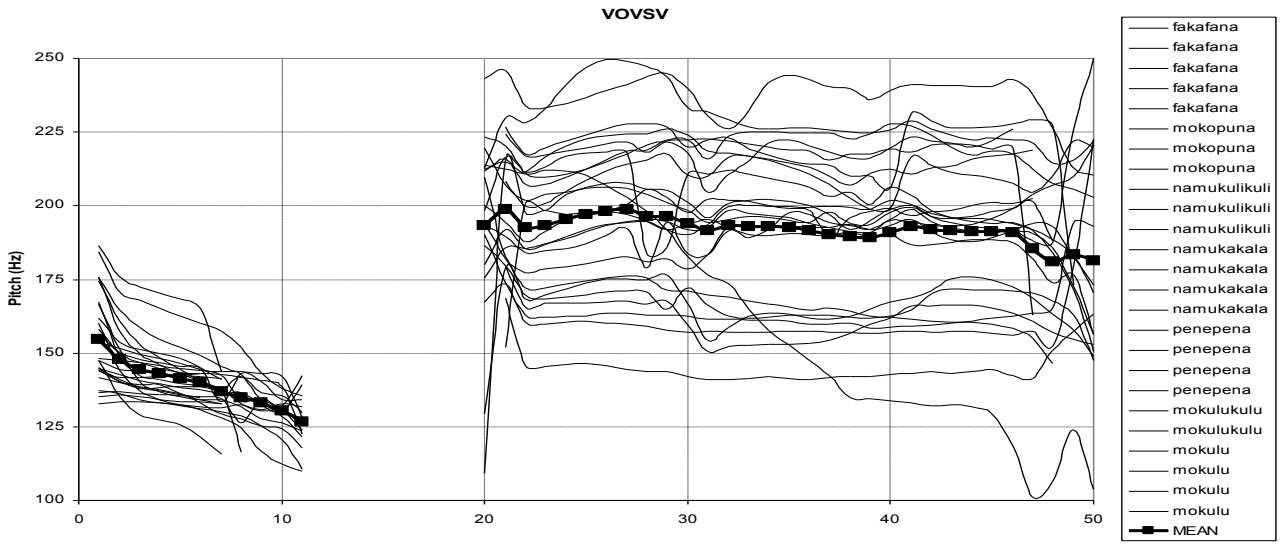

FIGURE 6. Normalized alignment data from VOV SV sequences accented with a LH*. Due to microprosodic effects, the stressed vowel shows relatively level high pitch. No rise is seen because pitch is boosted by a preceding obstruent.

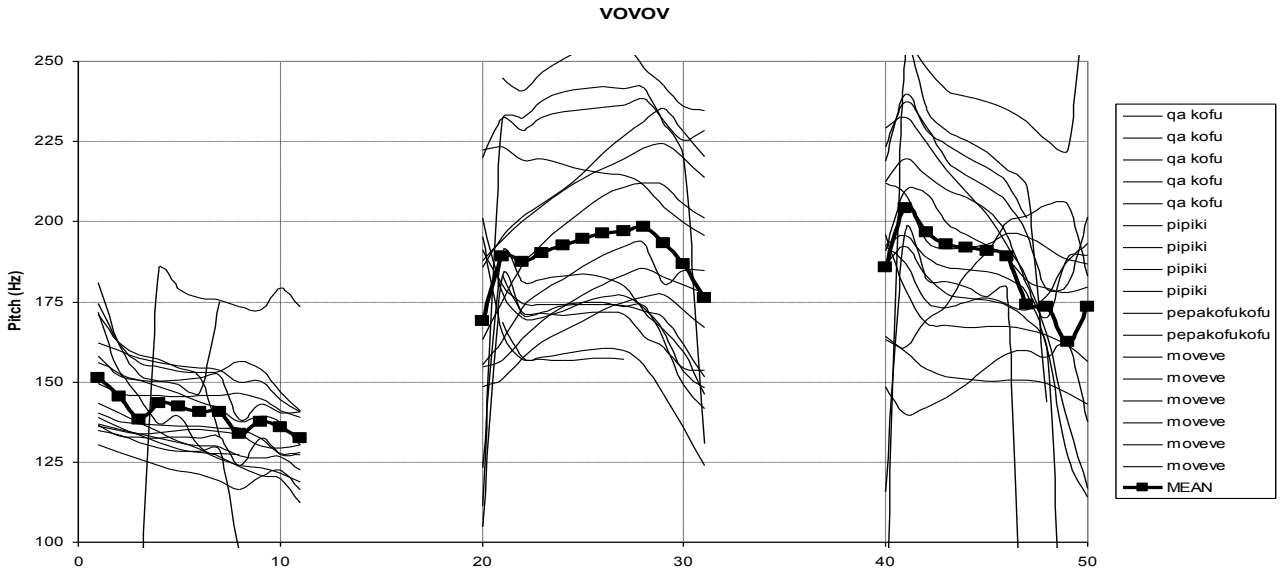

FIGURE 7. Normalized alignment data from VOV OV sequences accented with a LH*. Pitch is high coming out of the obstruent preceding the stressed vowel, and falls into the following obstruent.

Lastly, in the case of long vowels, or rather two identical vowels in a row, when the first vowel of the two is stressed, LH* alignment appears unchanged. The low target is aligned with the syllable onset, and the high target is roughly aligned with the end of the first vowel, or rather, the halfway point of the long vowel. This is shown in Figure 8. However, some tokens show a fairly steady rise across the two vowels. In this case, the pitch peak is realized at the end of the word.

When the second of the two vowels is stressed, the high target again aligns with the stressed vowel offset, but the low tone is not aligned with the stressed vowel onset. Rather, the low target stretches back into the preceding vowel and roughly aligns with the onset of that vowel, as shown in Figure 9.

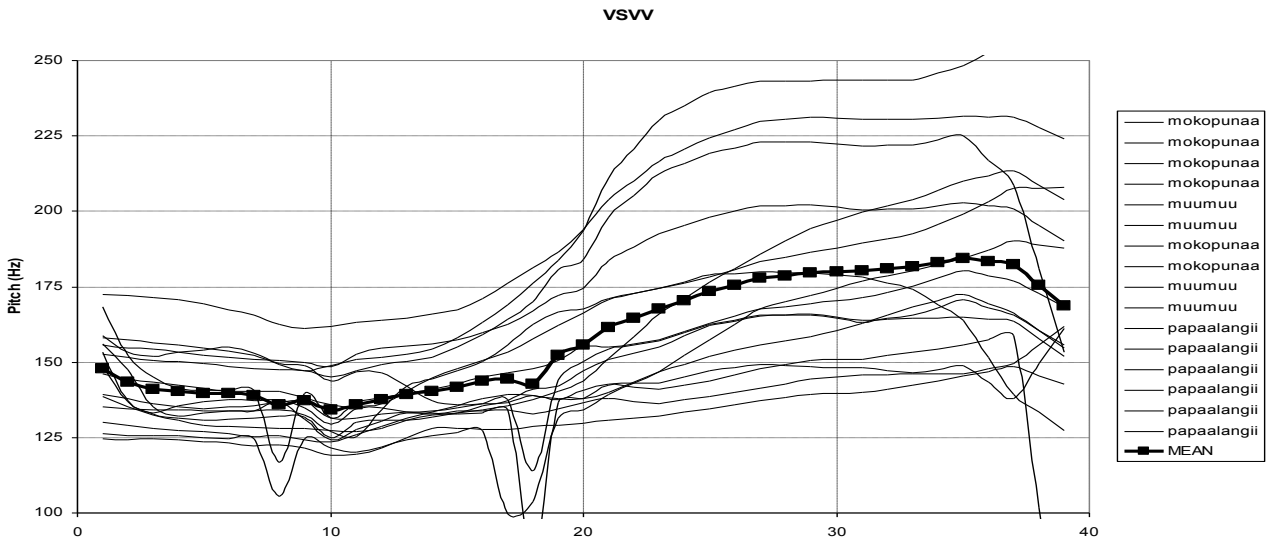

FIGURE 8. Normalized alignment data from VSV V sequences accented with a LH*. The low target aligns with the onset of the stressed syllable, and the high target aligns with the offset of the stressed mora, around the mid point of the VV sequence.

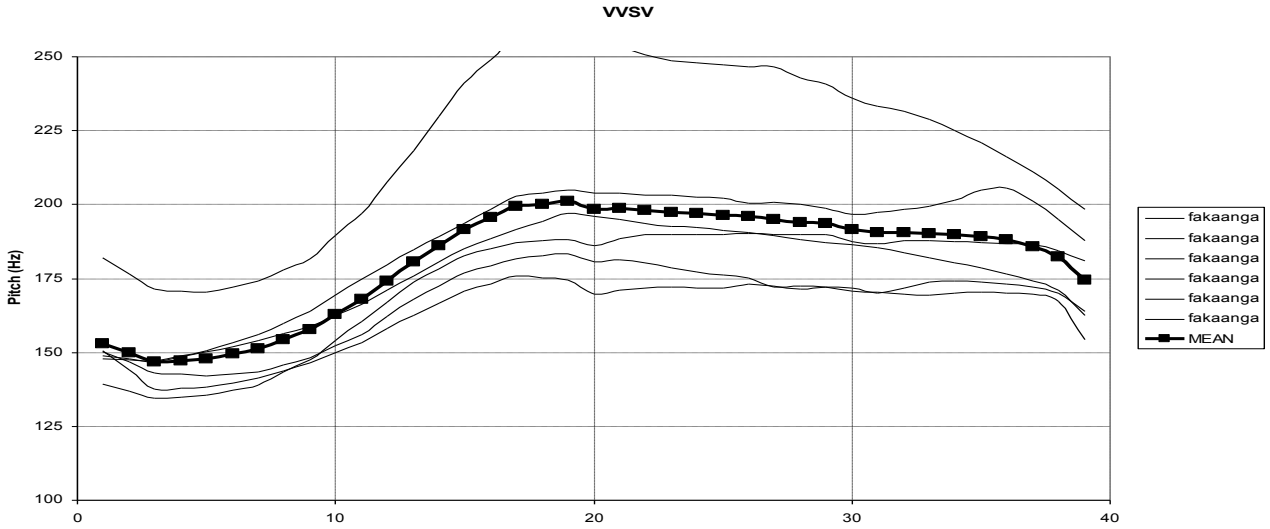

FIGURE 9. Normalized alignment data from VV SV sequences accented with a LH*. The high target aligns with the offset of the stressed vowel. The low target is aligned near the beginning of the preceding vowel.

Microprosodic effects may result in more than just shifted LH* alignment. We have observed many examples where the first syllable of an AP receives secondary stress, but does not show the rising LH* accent. Secondary stress in these cases is indicated not only by durational and intensity cues, but by a high pitch. Because there is no rise, this accent might best be marked with a simple high tone, H*. Figures 10 and Figure 11 demonstrate a minimal pair illustrating this type of accent.

However, we do not believe this accent to be underlyingly different from the LH* accent. Its appearance is restricted – it is only seen on the first syllable of an AP. The first syllable of an AP is usually part of some functional element, which is grouped together with the following lexical word. Most functional words in Tongan begin with a voiceless obstruent, such as *ʻoku, ʻe, ʻa, he, ke*, etc. These segments will cause the pitch immediately following to be higher than expected. As was seen in Figures 6 and 7, this may completely obscure the rising portion of the LH* accent, leaving only the

low-targeted interpolation on the preceding vowel and the high target on the stressed vowel. If the stressed vowel appears at the beginning of an AP, there is no preceding material available to display the low interpolation. Thus, the LH* accent would look more like a H*.

We propose that these conditions can cause a LH* to appear as a simple H* in Tongan. Thus, H* would be an allotone of LH*, occurring in a predictable environment, namely, the first syllable of an AP. We suggest that the rising pitch accent be transcribed in these cases as (L)H* in order to show that it is underlyingly the same accent, but that the low tone is not realized.

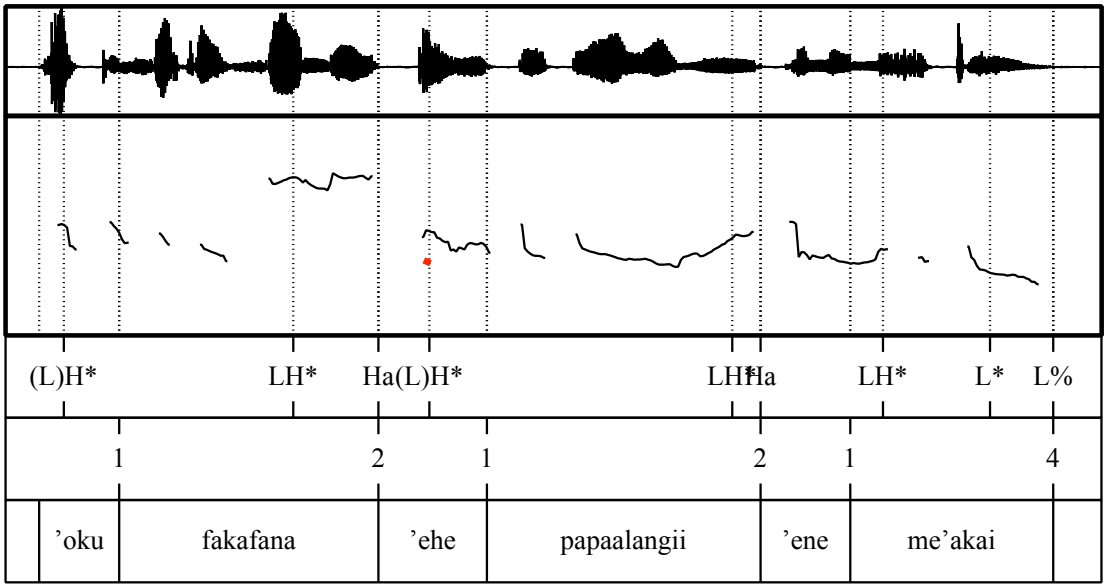

FIGURE 10. A pitch track of the sentence, "The white person is heating up their food." The first syllable in the second AP, *'ehe*, shows a (L)H* pitch accent.

'oku	*fakafana*	*'ehe*	*papaalangii*	*'ene*	*me'akai*
PRES	warm up	ERG	white person.DA	their	food

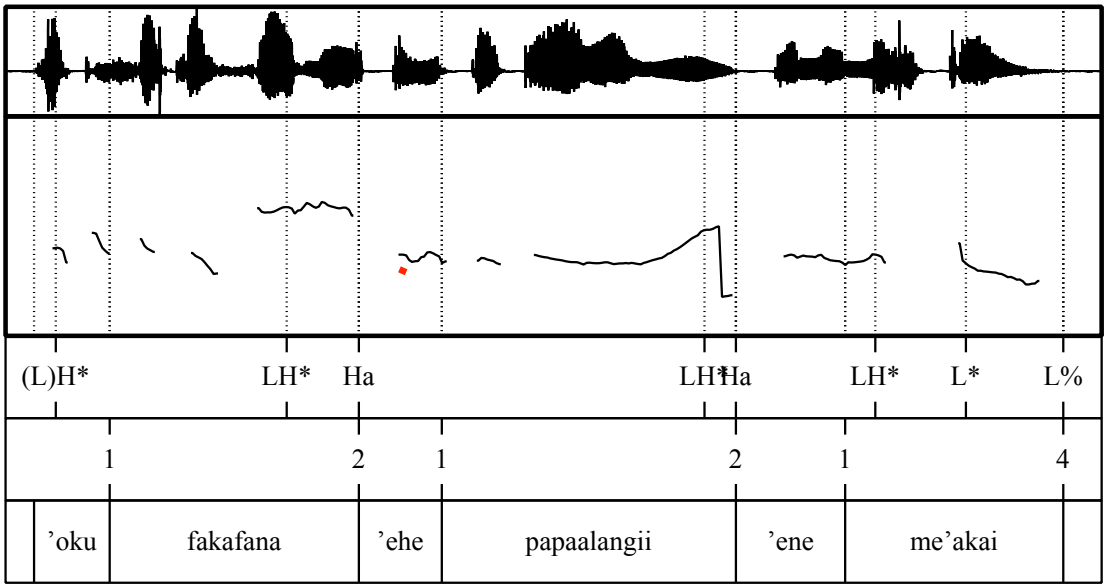

FIGURE 11. A pitch track of the sentence, "The white person is heating up their food." The first syllable in the second AP, *'ehe*, does not shows a clear pitch accent, in contrast with the utterance in Figure 10.

'oku	*fakafana*	*'ehe*	*papaalangii*	*'ene*	*me'akai*
PRES	warm up	ERG.HE	white person.DA	their	food

While the (L)H* allotone always appears on the first syllable of an AP, it doesn't always appear on secondary stress. Certain adverbials, such as *ia*, (untranslatable), or *mai*, "towards us," frequently appear in their own phrase. In this two morae phrase, the first mora of the AP is the primary stress, and can receive the (L)H* allotone. Coupled with the Ha edge tone, these words can receive a plateaued pitch contour, as in Figure 12.

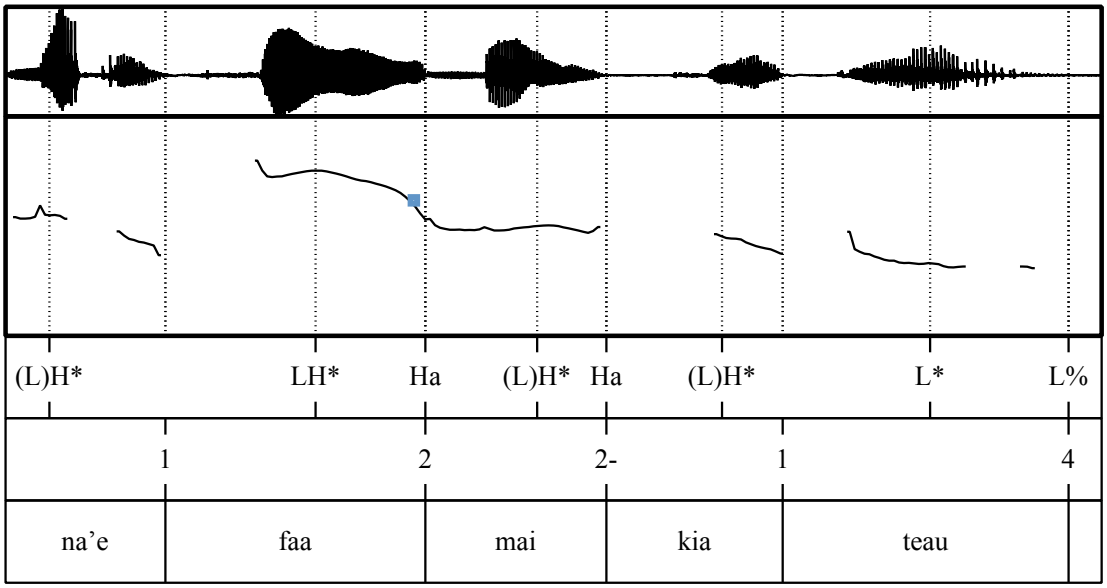

Figure 12. A pitch track of the sentence, "He reached out to me." The adverbial *mai* forms its own AP, with an (L)H* pitch accent and a high edge tone, Ha, causing a plateaued pitch contour.

na'e	*faa*	*mai*	*kia*	*teau*
PST	reach	to us	to	us

3.1.2 The Final Pitch Accent L*

The second pitch accent type in Tongan is a bit of a mystery. Currently, we are calling this accent L*. It only seems to appear on the final stressed syllable of an IP, most usually in declaratives. It has extremely low pitch and is often very difficult to distinguish from the declarative final L% boundary tone. It can be seen in many of the figures given above. One might wonder whether there is an accent there at all, and indeed this is a valid concern. However, we believe there must be some pitch accent in this location. It is unlikely that these are cases of deaccenting because (a) as will be discussed below, Tongan does not seem to show any post-focus dephrasing or deaccenting, and (b) even if that conclusion is false, the frequency of occurrence for this accent elicited in broad focus conditions is too high to be considered cases of accidental focus. Also, there are many cases where the IP-final word is long and receives secondary stress, accented with a LH*, yet the primary stress receives the mysterious L* accent, as in Figure 13. If the L* is not real, it would be very strange in these cases to accent the secondary stress of a word, but not the primary stress. Therefore, we assume there is some real pitch accent here.

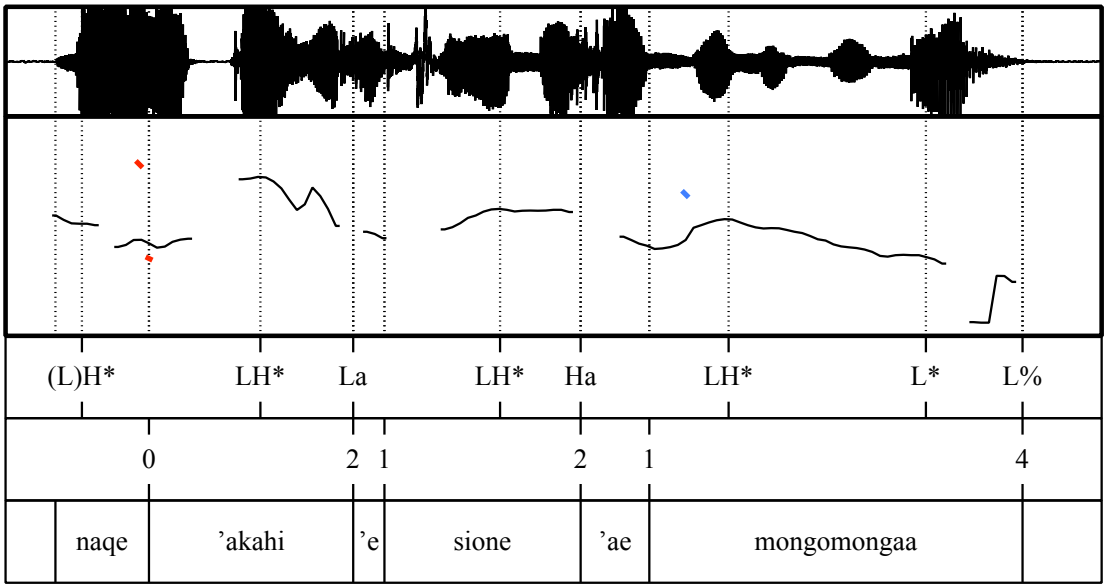

FIGURE 13. A pitch track of the sentence, "John kicked the roach." Red lines show the pitch range over the course of the utterance. The final word, *mongomongaa* is realized with two pitch accents, a LH* on the secondary stress, and an L* on the primary stress. Interpolation between these two accents, indicated by the blue line, falls more rapidly than declination.

na'e	*'akahi*	*'e*	*sione*	*'ae*	*mongomongaa*
PST	kick	ERG	John	ABS.E	roach.DA

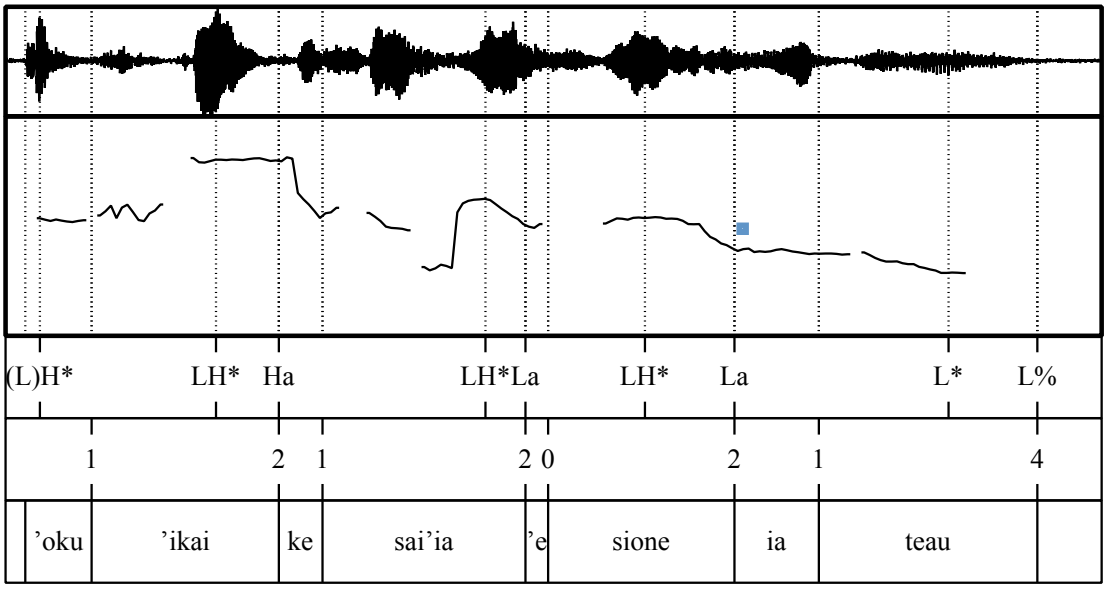

FIGURE 14. A pitch track of the sentence, "John doesn't like me." A pitch plateau can be seen extending from the onset of the final AP, *ia teau*, to the L*.

'oku	'ikai	ke	sai'ia	'e	sione	ia	teau
PRES	NEG	KE	like	ERG	John		me

We propose this accent to be transcribed as a L* because we hear a localized falling pitch contour on the stressed syllable in much of our data, and can occasionally observe this fall in the pitch track in very clearly produced, modally voiced utterances, such as Figures 13 and 14. Alignment data also suggests a low falling contour. As in Section 3.1.1, we conducted a small pilot experiment examining the alignment of this pitch accent. Several words were recorded in sentence final position, where the stressed syllable received the L* accent. Each word was recorded a few times each, and again, only recordings from our female consultant were analyzed. Stressed syllables appeared in two segmental environments, VSV SV and VSV V. Pitch was measured using the Straight algorithm in VoiceSauce. Ten equally spaced measurements were made for each segment, allowing pitch tracks to be normalized across varying segmental durations.

Figure 15 shows the VSV SV condition. We found that pitch tends to fall gradually into the stressed syllable. At the onset of the stressed vowel, the pitch contour takes a sharp downward turn, forming a shoulder in the pitch track. At the stressed vowel offset, the speed of pitch fall reduces, and pitch falls more gradually until the end of the IP. It is because of our perception and this pitch shoulder that we propose a falling contour. However, as can be seen in Figure 16, the VSV V condition, this pitch shoulder is not always obvious. Thus, the existence of a final falling contour is not so clear cut.

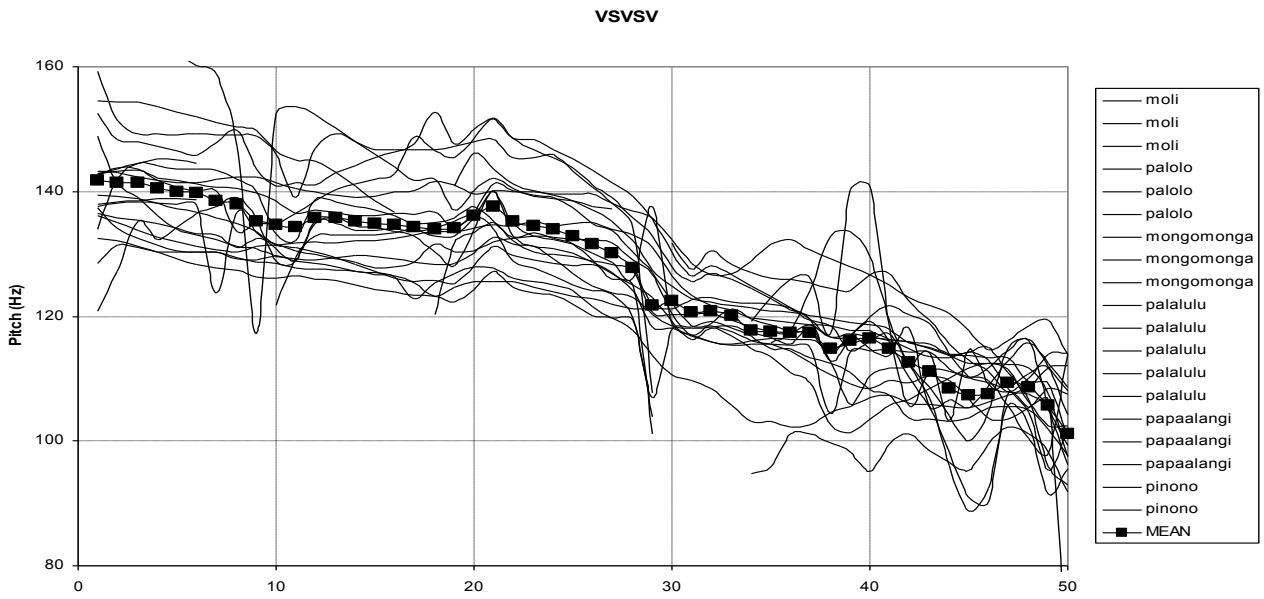

FIGURE 15. Normalized alignment data from VSV SV sequences accented with a L*. The rate of pitch fall increases at the onset of the stressed vowel, then reduces at the offset, forming a shoulder in the pitch track.

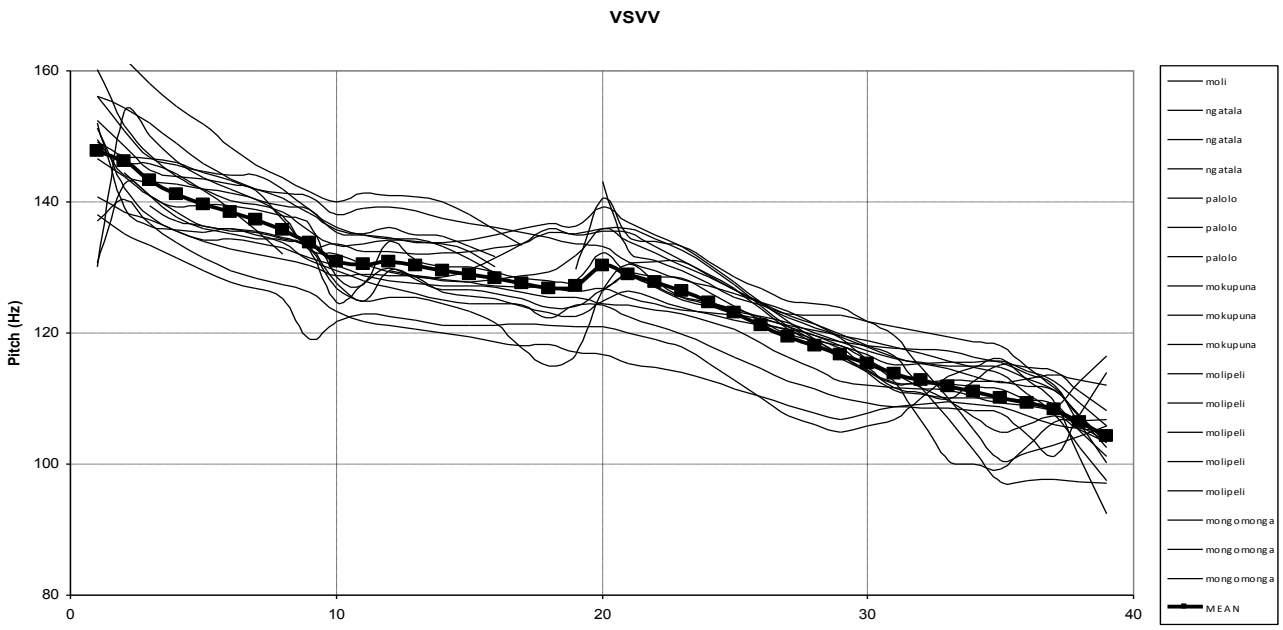

FIGURE 16. Normalized alignment data from VSV V sequences accented with a L*. The rate of pitch fall increases at the onset of the stressed vowel, but does not appear to reduce at the offset, as in the VSV SV condition.

Assuming the IP-final accent is falling contour, why do we propose L* over HL*? While it is true that HL* is a more typologically common label, it has implications about the behavior of this accent. . For example,, a HL* labeling would suggest that the fall would begin near the speakers high range, and that a plateau between a LH* and a HL* should be possible. These behaviors are not observed.

The pitch range of the L* is always exceedingly low. We never see a larger fall in an expanded pitch range. Also, the fall begins at or very near the bottom of the speaker's pitch range. Compare the utterances in Figures 17 and 18. In the first, the final pitch accent is realized as LH*, rather than L*. Red lines show the pitch range, which shows natural declination over the course of the whole utterance. Each LH* pitch accent rises from the bottom of the range to the top. In contrast, Figure 18 shows an utterance with a final L*. Again, the red lines show the pitch range, which declinates over the utterance. The highest point of the L*, highlighted in blue, begins at the bottom of the pitch range and falls lower, not the top, as would be expected with a HL*. Secondly, the interpolation from a LH* to a L* falls more rapidly than declination. Interpolation between two high targets, LH* HL*, should fall at the same rate as declination. The blue line in Figure 13 above illustrates this behavior. Lastly, as will be discussed below, APs begin with a neutral, mid-to-low pitch. Occasionally, we observe plateaus from this starting mid-to-low pitch to the L*, as in Figure 14 above. If the final accent were a HL*, we might expect the pitch to rise.

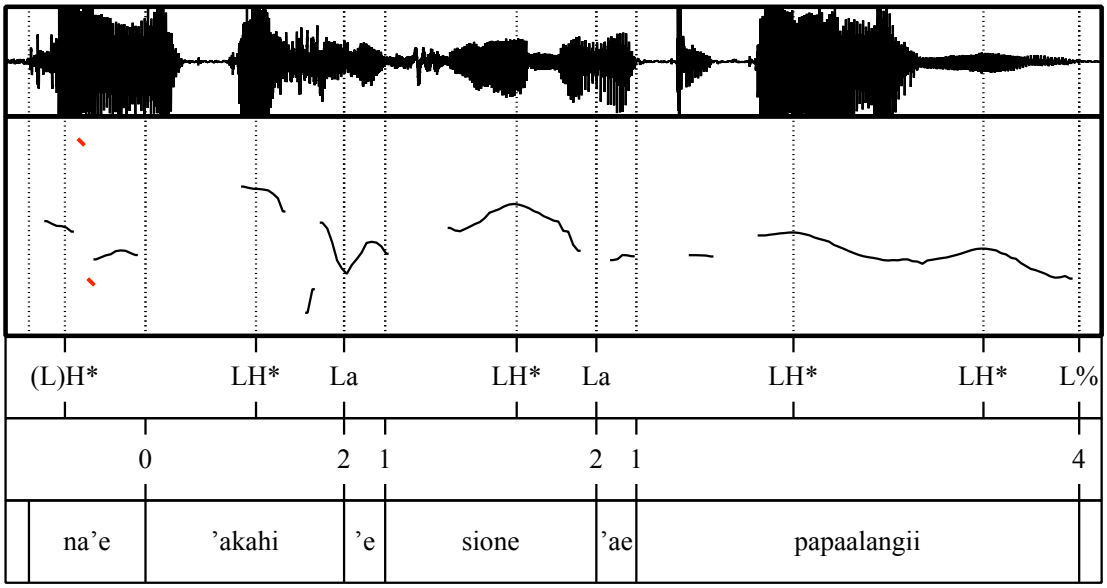

FIGURE 17. A pitch track of the sentence, "John kicked the white person." The final word, *papaalangii*, shows the definite accent realized with an LH* rather than the more typical final L*. Red lines show the pitch range over the course of the sentence. The LH* all rise from the bottom line to the top.

na'e	*'akahi*	*'e*	*sione*	*'ae*	*papaalangii*
PST	kick	ERG	John	ABS.E	white person.DA

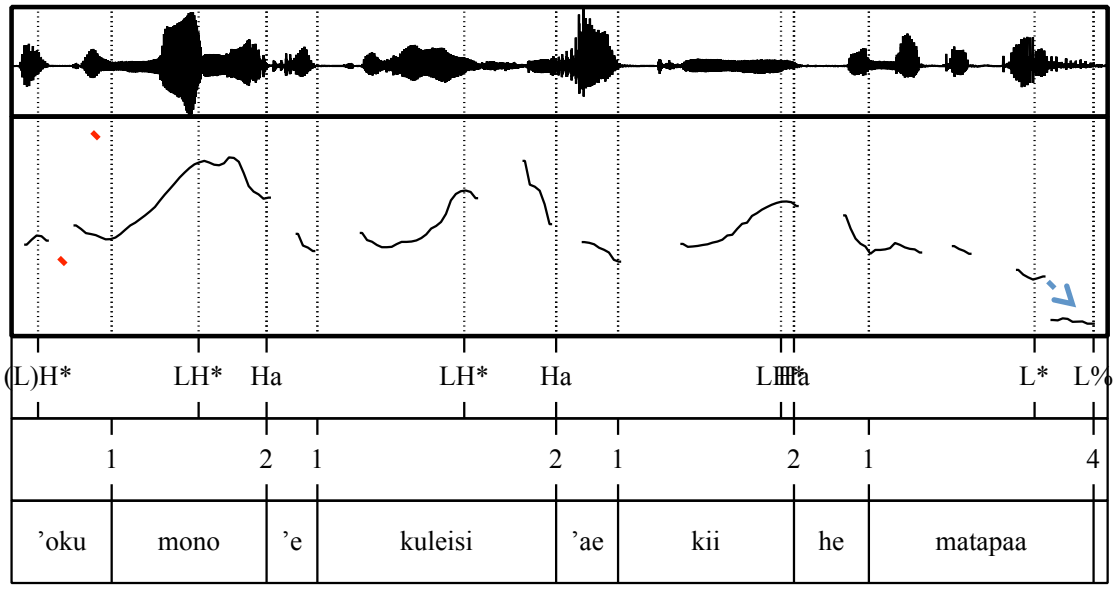

FIGURE 18. A pitch track of the sentence, "Grace is putting the key into the door." The final word, *matapaa*, is realized with an L* pitch accent. Red lines show the pitch range over the course of the sentence. The blue arrow shows that L* begins at the bottom of the pitch range and falls lower.

'oku	*mono*	*'e*	*kuleisi*	*'ae*	*kii*	*he*	*matapaa*
PRES	put	ERG	Grace	ABS.E	key	into	door

Although we chose to label the final accent as a L* instead of a falling annotation such as ML* because even if we hear a localized fall in much of our data, there are many examples where the fall is not perceptible. The alignment data is not so clear, either. Although a pitch shoulder was visible in the aggregate in the VSVSV condition, not all of the individual tokens show this falling pattern. And, a pitch shoulder is not so easily seen in the VSVV condition. Lastly, many of the points of evidence supporting the choice of ML* over HL* could support a simple L* label, as well. Namely, the final pitch accent begins at the bottom of the pitch range. This is where an L* would be expected. Under this analysis, any final fall could be explained as an L* L% contour. In English, the L% falls lower than a preceding L- tone. This could be true in Tongan as well.

3.2 Boundary Tones

In our analysis, Tongan has two prosodic constituents at and above the word: the Accentual Phrase (AP), and the Intonational Phrase (IP). The AP and the IP are the two phrases in Tongan marked by intonation. An AP contains at least one pitch accent, and it is not followed by a pause unless it is the last phrase of an IP. An AP is marked with an AP-final edge tone. An IP, on the other hand, contains one or more APs and an IP-final boundary tone. An IP boundary tone is realized on the IP-final syllable and is followed by a pause.

3.2.1 Accentual Phrases (AP) – Ha and La

An accentual phrase consists of one or more pitch accents and an AP-final edge tone. The AP-final tones are realized on the final syllable of the accentual phrase and is realized with either a high tone (Ha), or a low tone (La). The left edge of an AP is not marked by any special tone. Rather, pitch resets at the beginning of an AP to a neutral mid-to-low pitch. This is illustrated in Figure 19

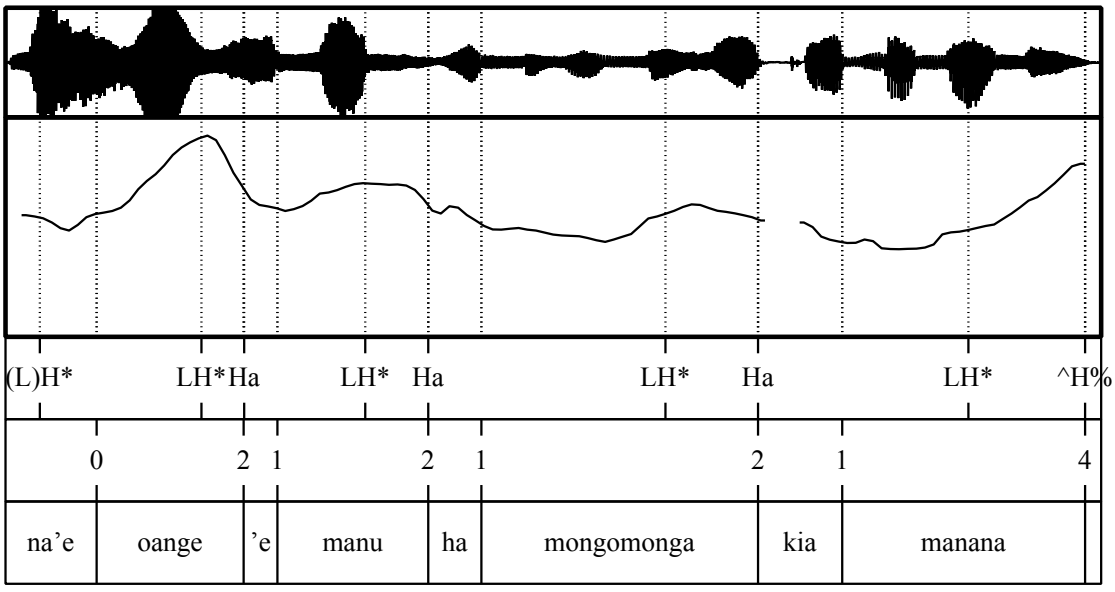

FIGURE 19. A pitch track of the sentence, "Did Manu give a roach to Manana?" A series of APs is visible, each ending in an edge tone and beginning with mid-to-low neutral pitch.

na'e	*oange*	*'e*	*manu*	*ha*	*mongomonga*	*kia*	*manana*
PST	give	ERG	Manu	INDEF	roach	to	Manana

An AP usually contains one lexical word and all preceding functional elements. For instance, the first AP in (5) would include the lexical word *mongomonga* and the two preceding functional words *ko* and *e*, which are the focus marker and the referential article respectively.

(5) *ko e mongomonga 'a manana*
FOC E roach ABS Manana
"This is Manana's roach."

There are several reasons why we propose the level of an accentual phrase rather than the level of an intermediate phrase. First, the length of the prosodic unit is short, typically only one or two lexical words long. Second, there is no clear durational lengthening in the phrase-final syllable, which is typologically common for intermediate phrases, nor is there any clear juncture at the end of each phrase. In Figure 19, the first two APs have no juncture between them. Lastly, intermediate phrases, in the languages that have them, are often associated with pitch spreading or pitch reset. In Germanic languages, for example, the intermediate phrase tone spreads from the boundary to the end of the nuclear pitch accented word, forming lengthy pitch plateaus, while in Greek, the intermediate phrase tone can shift to the nearest stressed syllable, if that syllable is unaccented. No such spreading behavior is observed in Tongan. Nor is there any pitch reset. As can be seen in all the previous examples, pitch does not reset after an AP boundary, nor is declination broken. Therefore, we find it unlikely that these phrases are intermediate phrases.

A second alternative to the AP is to have no small phrasing unit at all. This proposal would leave Tongan with only a single tonally-marked phrase, the IP. Although one might argue in favor of this analysis because of the lack of juncture between APs, this analysis would be hard pressed to explain the behavior of the pitch contour at the AP boundary. Specifically, pitch following an AP boundary falls rapidly to a mid-to-low pitch, and then interpolates, often as a low plateau, to the next LH* accent, as be clearly seen in Figures 3 and 11. If no boundary is proposed, then that obvious low target would have to be explained by some other method, such as a pitch accent. But, these syllables are very weak, and so a pitch accent seems unlikely. Also, there is a difference in pitch behavior between the proposed AP boundaries and interpolation between pitch accents. Figures 20 and 21 illustrate this difference. When two LH* pitch accents appear on the same word (Figure 20), pitch interpolates smoothly between them. It does not fall quickly and form a low plateau (Figure 21) as it does at an AP boundary. It is for these reasons we propose Accentual Phrasing for Tongan.

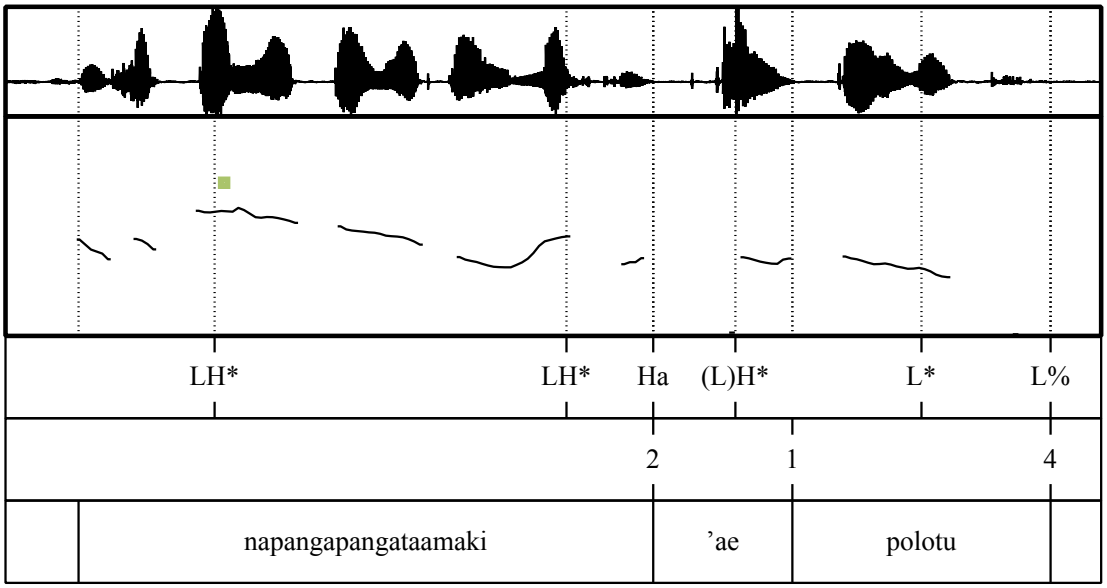

FIGURE 20. A pitch track of the sentence, "The religious ceremony didn't go well." The word, *napangapangataamaki*, has an accented primary stress and an accented secondary stress. Pitch interpolates smoothly between the two LH*'s, in contrast with the pitch behavior in Figure 21.

napangapangataamaki	*'ae*	*poolotu*
go well	ABS.E	religious ceremony

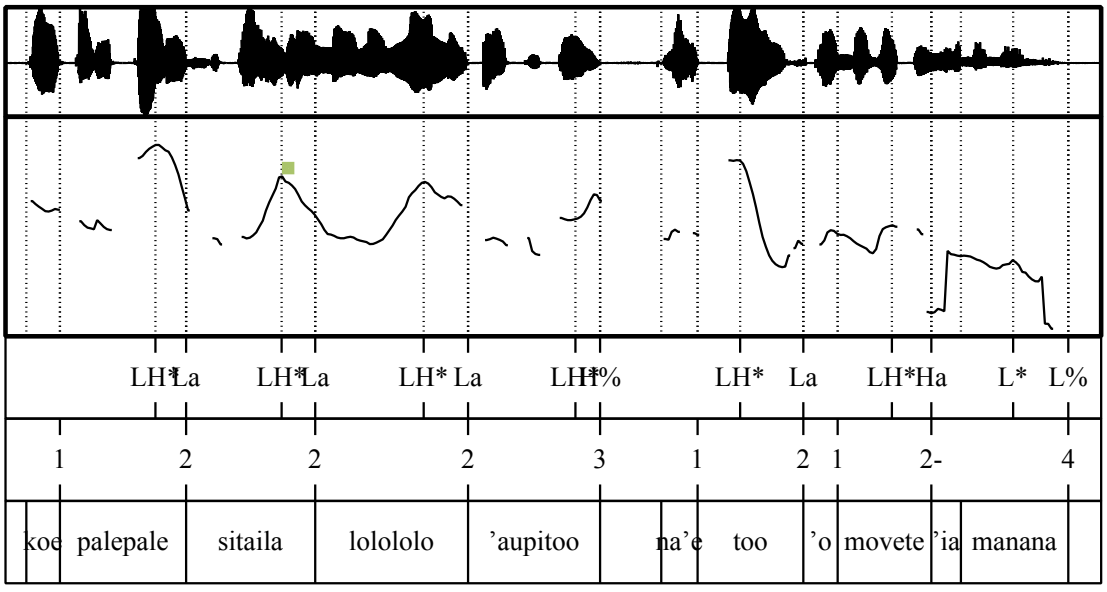

Figure 21. A pitch track of the sentence fragment, "The very stylish oily porch covering." There is a proposed AP boundary between *sitaila* and *lolololo*, where pitch falls to a low target and then interpolates as a low plateau to the following LH*.

koe	*palepale*	*sitaila*	*lolololo*	*'aupitoo*
FOC.E	porch covering	stylish	oily	very.DA

As mentioned, there are two AP-final edge tones: Ha and La. Ha and La are equally common in Tongan. The La edge tone is realized s a low tone at the end of the phrase. In Figure 22, there is a fall in pitch after the predicate *moveveveve* 'to be messy', thus it is labeled with La.

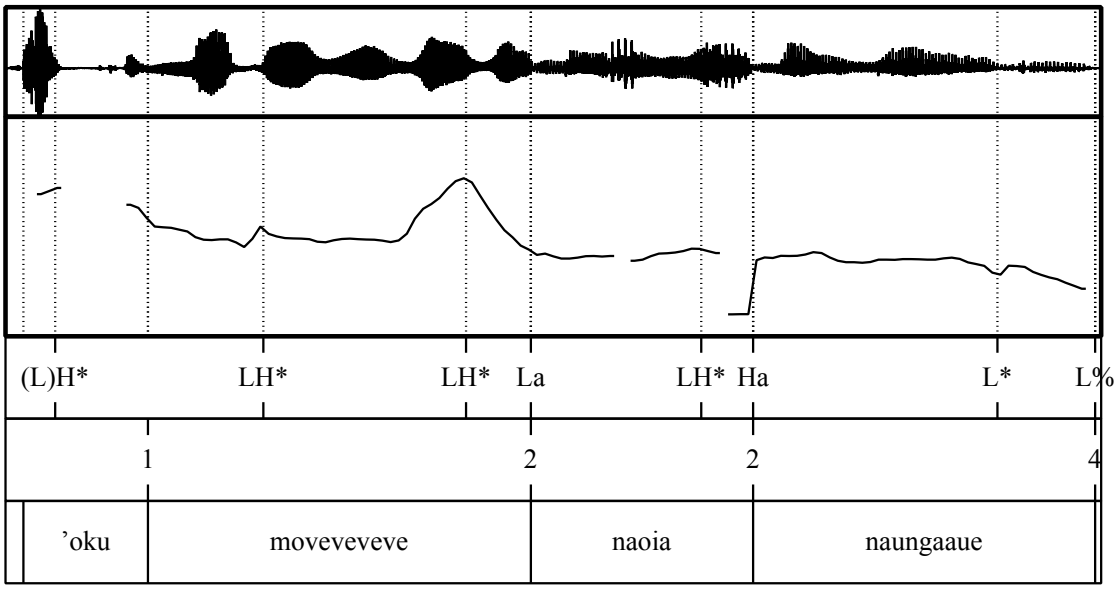

FIGURE 22. A pitch track of the sentence, "The work is a mess." The first AP ends with an La.
'oku moveveveve nao ia naungaaue
PRES messy work

Ha edge tone is the most frequently observed AP-final tone in our data. It has roughly the same f0 value as the peak of the most recent LH* accent in the phrase, forming a plateau between the pitch accent peak and the end of the phrase. Sometimes the f0 contour of Ha in the pitch track displays a slight rise from a preceding LH*, though this typically occurs over a final VV sequence. As will be discussed below, in IP-final position, we have a contrast between a plateau-inducing boundary tone, H%, and a super high ^H%. Perceptually, these IP-final boundary tones are quite distinct. However, the slight rise seen at the end of some APs neither rises to the same degree nor even sounds like a particularly noticeable rise. Therefore, we use Ha to label both an AP-final high plateau and an AP-final slight rise. Figure 23 is an example of a sequence of Ha's.

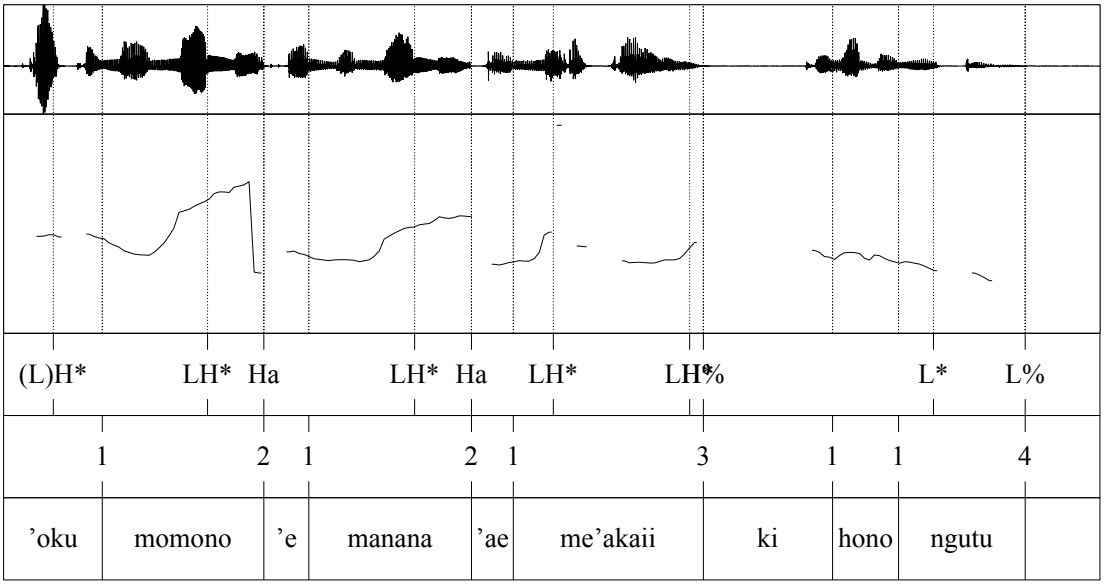

FIGURE 23. A pitch track of the sentence, "Manana is shoving the food into her mouth." The first two AP's each receives a final Ha edge tone. The sudden drop in pitch track at the first AP boundary is cause by irregular phonation in preparation for the following glottal stop, yet the pitch stayed high.

'oku	*momono*	*'e*	*manana*	*'ae*	*me'akaii*	*ki*	*hono*	*ngutu*
PRES	shove	ERG	Manana	ABS.E	food.DA	in	her	mouth

3.2.2 Intonational phrase (IP) – L%, H%, ^H% and LH%

An intonational phrase is the largest tonally marked unit in Tongan, and is often the size of a simple sentence or a larger phrase. In careful speech, each accentual phrase may form its own IP with the occurrence of the juncture. Tongan has four IP boundary tones – L%, H%, ^H% and LH%.

The L% is the most common IP boundary tone, occurring at the edge of almost all declaratives, as well as some *wh*-questions. It is characterized by the steady falling pitch beginning at the IP-final pitch accent.

The high IP boundary tone (H%) is the inverse of the L% in terms of the realization. It is used at the accentual phrase with a clear following juncture, as shown in Figure 24. In this figure, H% contrasts with an earlier Ha, which has no following juncture. Both H% and Ha form a plateau from the preceding LH*.

The upstepped high boundary tone, ^H%, is used on yes/no questions and echo questions. Figure 19 and 25 serve as the examples in which the yes/no questions end at a high pitch, higher than the peaks of any of the preceding pitch accents.

Lastly, the rising boundary tone, LH%, is manifested phonetically as a dip and then a slight rise to a mid f0 value. The occurrence of this boundary tone is rare and is found as the continuation contour in the middle of a sentence. This boundary tone can be found in Figure 23 and Figure 26. The third boundary tone in Figure 23 and the second boundary tone in Figure 26 is a LH%, which is preceded by a LH*.

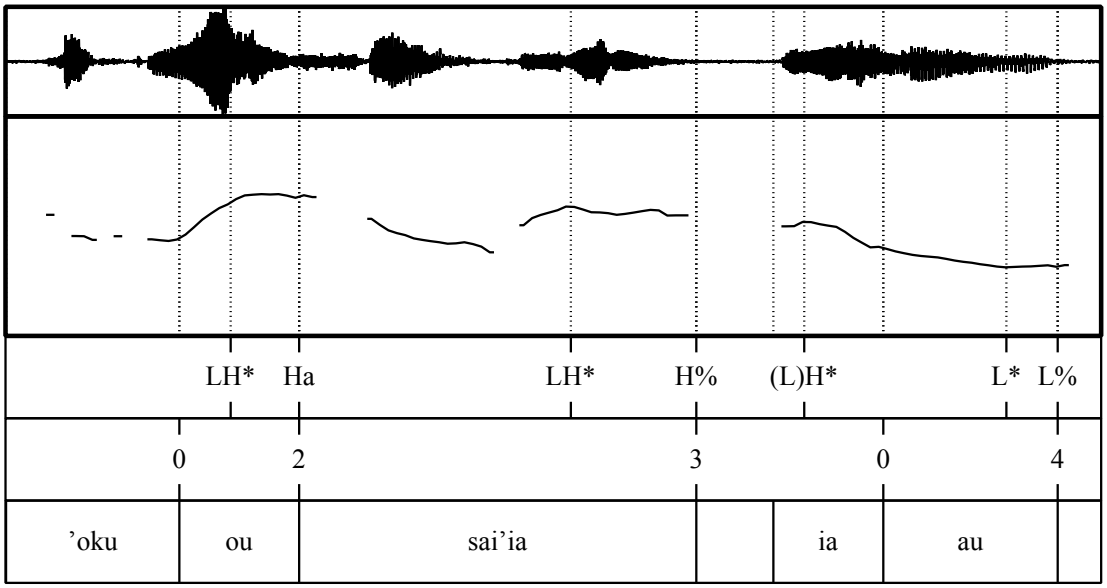

FIGURE 24. A pitch track of the sentence, "I like myself." An IP final H% appears because there is a clear juncture comes after. This IP boundary tone overrides the original AP boundary tone, namely Ha.

'oku	*ou*	*sai'ia*	*ia*	*au*
PRES	I	like		I

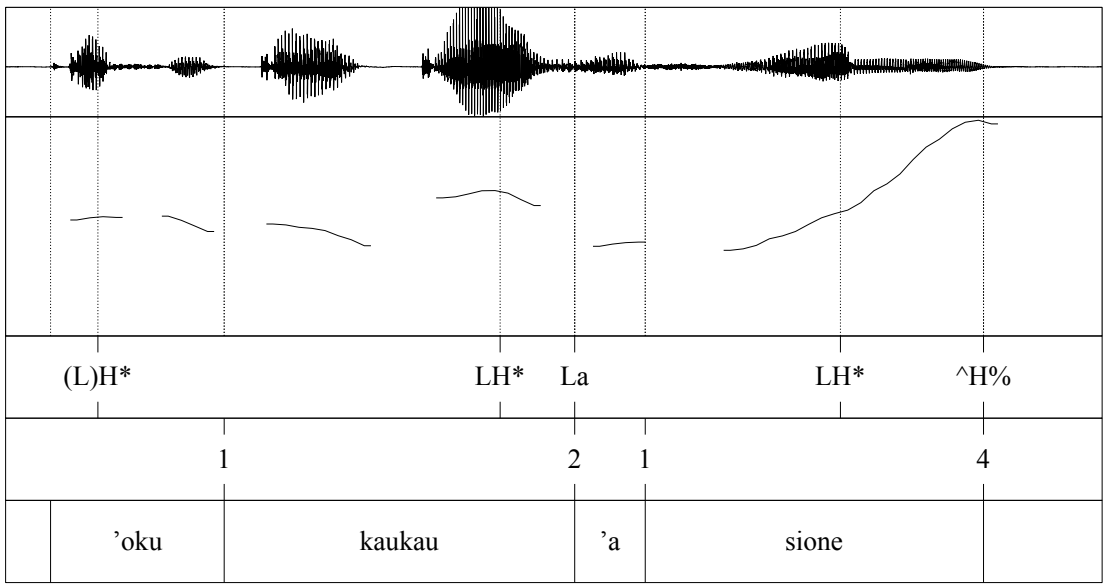

FIGURE 25. A pitch track of the sentence, "Is John taking a bath?" The yes/no question ends at a super high boundary tone, ^H%, whose pitch is much higher than the preceding LH*'s.

'oku	*kaukau*	*'a*	*sione*
PRES	bathe	ABS	John

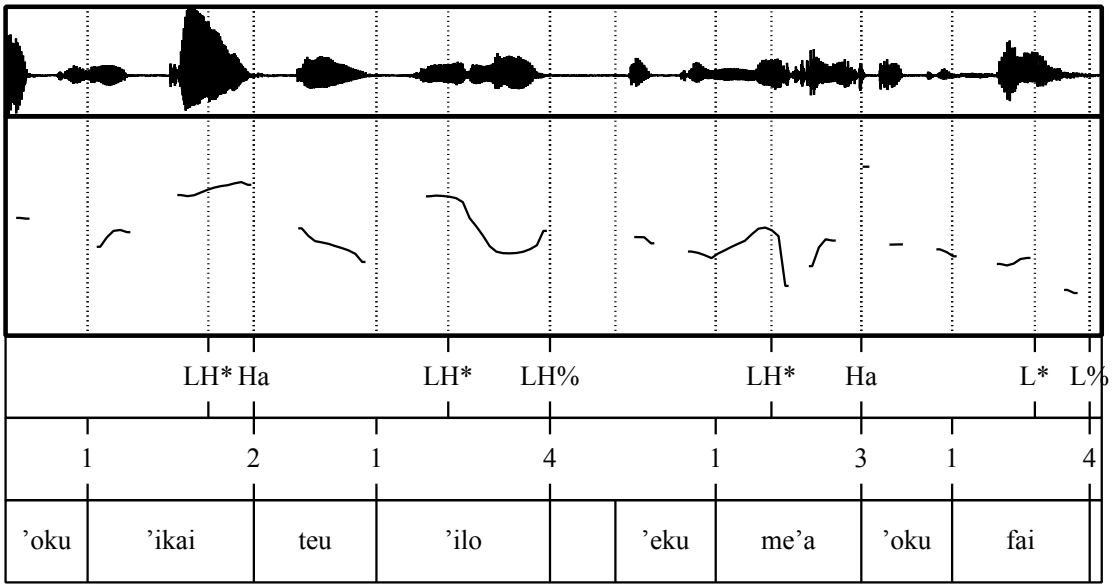

FIGURE 26. A pitch track of the sentence, "I don't know what I am doing." The second boundary tone is a LH% preceded by a LH* pitch accent.

'oku	*'ikai*	*teu*	*'ilo*	*'eku*	*me'a*	*'oku*	*fai*
PRES	NEG	about	know	I		PRES	do

3.3. Break indices

The break indices are proposed to represent the degree of juncture perceived between words. Table 1 describes the inventory of the break level and diacritics proposed in this model.

Table 1

Break index	Description
Basic break index values	
0	Reduced/encliticized boundary; weaker than word boundary
1	Word boundary
2	AP boundary
4	IP boundary
Mismatch	
2-	Mismatch between 1 and 2 (either break index of 1 but has an AP boundary tone or break index of 2 but has no AP boundary tone)
3	Mismatch between AP and IP juncture (either perceive 2 with unexpected tonal marker or lengthening which are suitable for break index of 4 or vice versa)
Diacritic	
p	Perceived hesitation or disfluency

4. Sentence Types

4.1 Declaratives

All declarative sentences are marked by the low boundary tone (L%), as in most of the figures above. Figure 27 and 28 demonstrate the pitch tracks of two complex declarative sentences, double object construction and coordination respectively, and they all ends with L%.

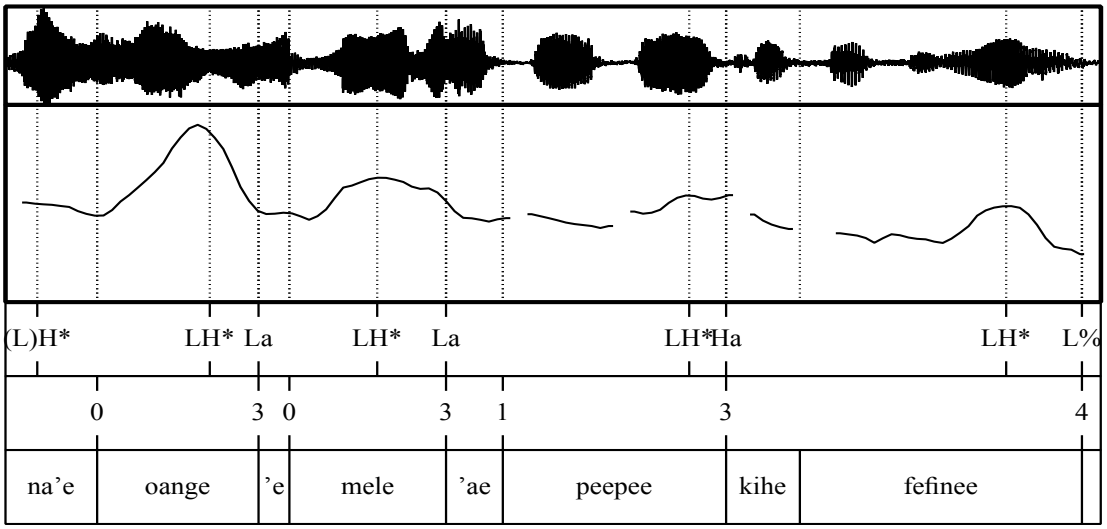

FIGURE 27. A pitch track of the sentence, "Mele gave the baby to the woman."
na'e oange 'e mele 'ae peepee kihe fefinee
PST give ERG Mele ABS.E baby for woman.DA

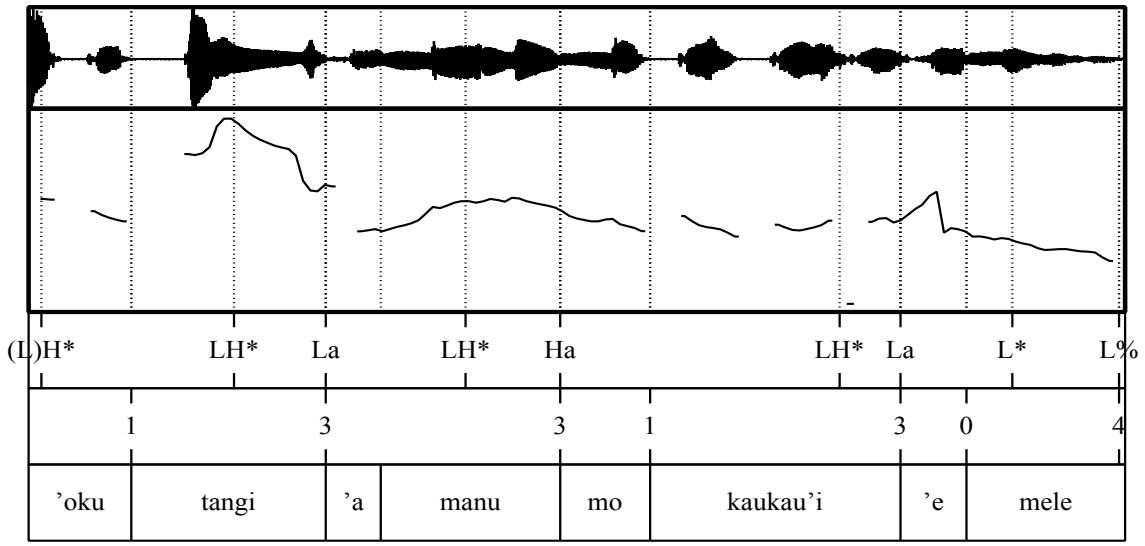

FIGURE 28. A pitch track of the sentence, "Manu is crying and Mele is bathing her."
'oku tangi 'a manu mo kaukau'i 'e mele
PRES cry ABS Manu and bathe ERG Mele

4.2 Yes/no questions

The sentence structure of a declarative sentence and a yes/no question is identical. The interpretation of the sentence is dependent on the IP boundary tone. To be more specific, the IP boundary tone of a declarative sentence is marked with L% whereas the IP boundary tone of yes/no question is marked with ^H%. Figure 29 demonstrates the pitch contours of (6) with different sentence types.

(6) *ko* *e* *faanau* *'a* *mele*
FOC REF children ABS Mele
'They are Mele's children.' or 'Are they Mele's children?'

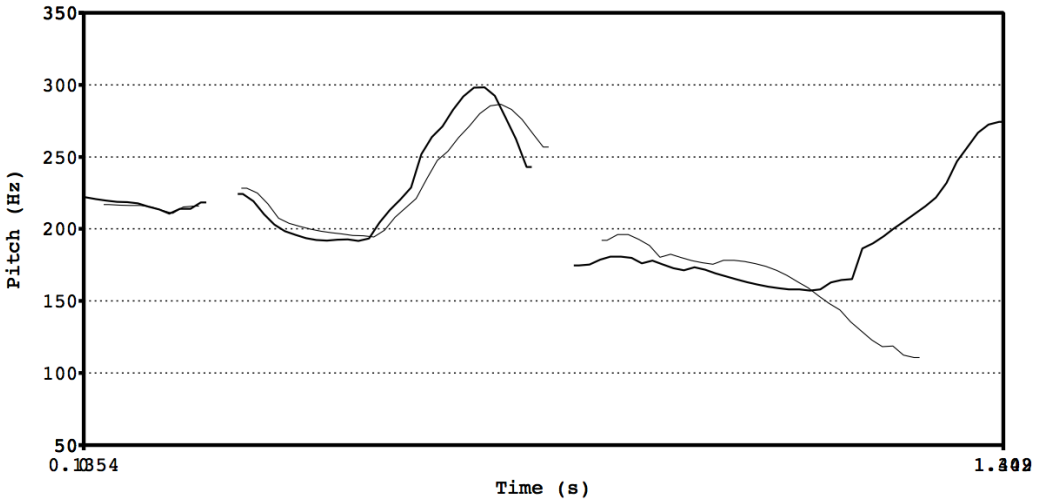

FIGURE 29. A pitch track of (6) produced with two sentence types: declarative and yes/no question. The dark-colored line is the yes/no question pitch contour and the light-colored line is the declarative pitch contour.

5.3 *Wh*-questions

The default tonal pattern of *wh*-questions in Tongan is similar to that of the declarative sentences in that the sentence-final boundary tone is L%, as in Figure 30. The *wh*-word *haa* stays in-situ and does not have different phonetic realization from other lexical words.

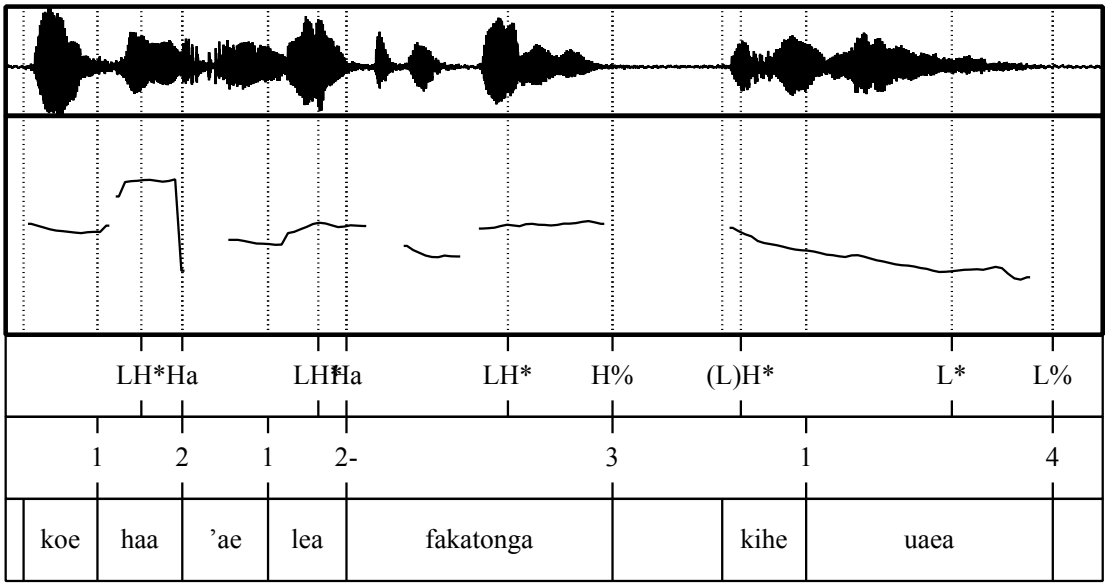

Figure 30. A pitch track of the *wh*-question, "What is the Tongan word for 'wire'?" The sudden fall of the first Ha is due to the irregular phonation.

koe	*haa*	*'ae*	*lea*	*fakatonga*	*kihe*	*uaea*
FOC.E	what	ABS.E	speak	Tongan	for	wire

5.4 Echo question

The echo questions with a *wh*-word, like yes/no questions, have ^H% as the IP boundary tone. This is shown in Figure 31. This is an echo question in response to a declarative sentence. The context is that speaker A asked speaker B to hand him a softening mango, and speaker B responded 'A what?'.

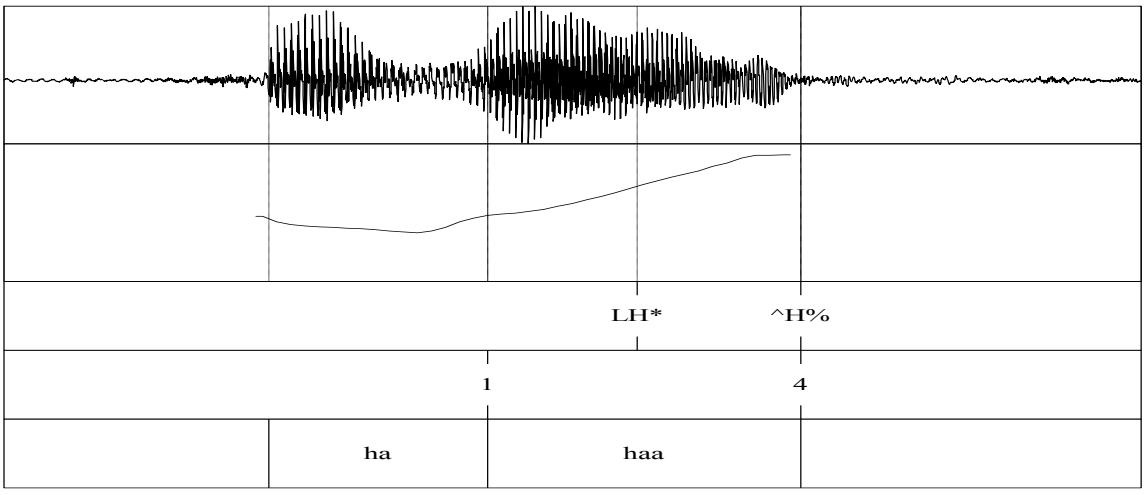

Figure 31. A pitch track of the echo *wh*-question, "A what?"

ha	*haa*
INDEF	what

5.5 Focus

Focus in Tongan appears to be primarily indicated through syntactic means. For example, Tongan has a topicalization construction involving the word *ko*, which moves a noun phrase to the beginning of the sentence, as seen in the examples given in (3) above. Emphasis may be marked with other grammatical elements like *pee*, "only," or the difficult to translate *ia* particle. There is no obvious intonational marker of focus in Tongan. Focused elements do not receive a unique pitch accent, nor is there any post-focus hammer effect (dephrasing, deaccenting or reduced pitch range), as can be seen in Figure 32. In this sentence, *manana* is focused, offered as an answer to the question, "Who kissed John?" It has been shifted to the beginning of the sentence in a *ko* construction and has received LH* as the pitch accent and is not followed by any post-focus hammer effect.

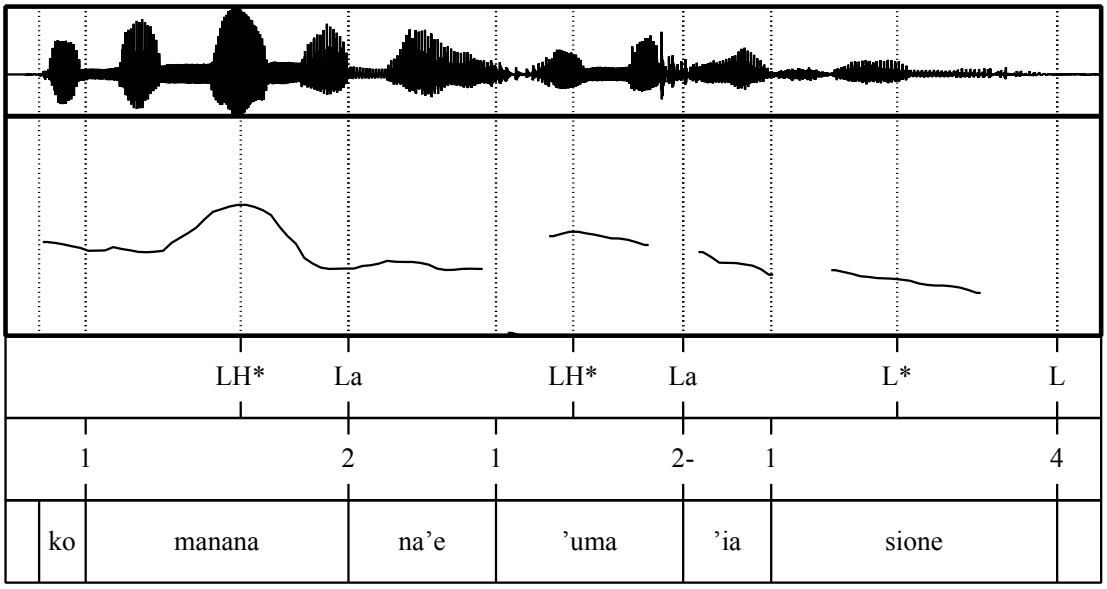

FIGURE 32. A pitch track of the sentence, "MANANA kissed John." This sentence was offered as an answer to the question, "Who kissed John?"

ko	*manana*	*na'e*	*'uma*	*'ia*	*sione*
FOC	Manana	PST	kiss	OBL	John

The prosodic indications of focus in focused elements are the expanded pitch range and the occasional greater intensity. This is difficult to see in the *ko* constructions as the focused element appears at the beginning of the sentence, where the pitch range is widest and intensity is often the greatest. However, when a focused word occurs at the end of the sentence, as shown in Figure 33.
the pitch range expansion is more obvious. This sentence was offered as a correction to the sentence "Manana killed a sea worm." *Mongomonga* is in contrastive focus, but it has not been shifted to the beginning of the sentence in a *ko* construction, but rather, has been left in-situ. It is marked with a LH* accent, but shows expanded pitch range. It should be noted that this word ordering is marked in this pragmatic context.

Perhaps a more natural occurrence of sentence-medial focus is shown in Figure 34. This example, "Manana is going to pick up Mele FROM the bus station," was offered in contrast to "Manana is going to take Mele TO the bus station." The preposition, *meihe*, which is focused, shows expanded pitch range, breaking the declination over the utterance and is also isolated in its own AP.

Normally, functional words like prepositions would be grouped together with a following lexical word into a single AP.

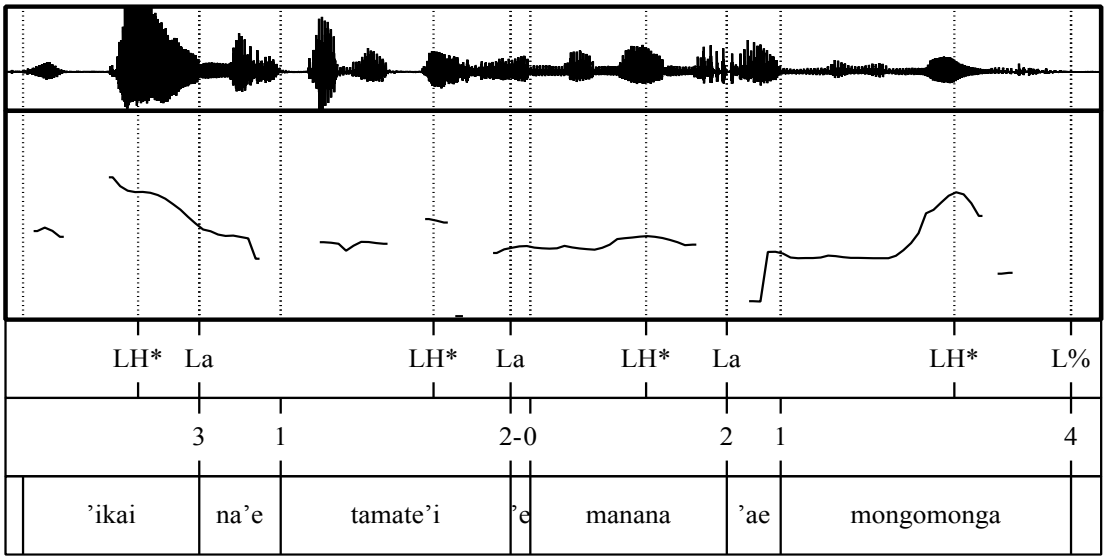

FIGURE 33. A pitch track of the sentence, "No, Manana killed a ROACH."
'ikai na'e tamate'i 'e manana 'ae mongomonga
No PST kill ERG Manana ABS.E roach

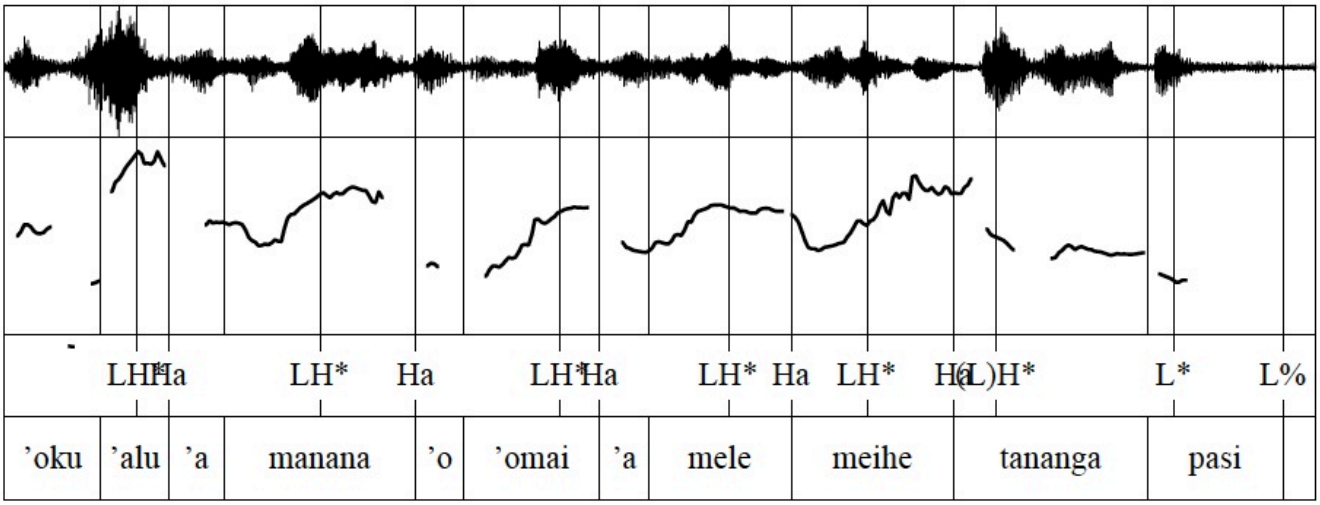

FIGURE 34. A pitch track of the sentence, "Manana is going to pick up Mele FROM the bus station."
'oku 'alu 'a manana 'o 'omai 'a mele meihe tananga pasi
PRES go ABS Manana CONJ bring ABS Mele from station bus

The only place where focus seems to receive specific tonal marking is in sentence-final position. In normal declaratives, the final pitch accent of a sentence is usually L*. However, we found several examples where the definite accent was focused in this position (these tokens were usually produced when our speakers were trying to emphasize the presence of the definite accent). In these cases, the final pitch accent was a LH*. It is from these examples that we conclude that focused elements must be produced with the LH* accent. However, this cannot be considered a focus-specific accent, since

it appears on all accented syllables (except for the final pitch accent in declaratives and *wh*-questions) in both focused and unfocused contexts.

6. Summary

The current proposed intonational model for Tongan reveals a limited tonal inventory and a prosodic structure composed of two tonally-marked phrases.

Stress in Tongan is predictable, appearing on the penultimate mora of a word, and is marked post-lexically with a pitch accent. Tongan appears to have only two pitch accents: a full rise, LH*, and a low, L*. Both pitch accent types are realized entirely on the stressed syllable – the first tone aligns with the syllable onset and the second aligns with the offset of the stressed mora. The LH* accent is more common than L* and it has a simple H* allotone, marked as (L)H*, which can appear on the first syllable of an AP. The L* has no observed allotones and only appears on the last stressed syllable of a sentence.

The tonally-marked phrases include the Intonational Phrase and the Accentual Phrase. AP's typically consist of one or two lexical words and any preceding functional words. They contain one or more pitch accents. Pitch resets at the left edge of an AP to a neutral mid-to-low level, but total pitch range is not affected. The right edge of an AP is marked with an AP-final edge tone: Ha and La. Ha and La are equally common in Tongan. The IP is the largest phrase and consists of one or more APs. It is marked on the right edge with a boundary tone: L%, H%, ^H% and LH%, and is often followed by a pause. Pitch slowly declinates over an IP.

Declarative sentences and *wh*-questions have an identical tune. Both end in a final fall, L%. Yes/no questions and echo questions, on the other hand, end with a super high rise, ^H%. Focus has no obvious prosodic marking. It is marked only with expanded pitch range, which breaks declination, and occasionally greater intensity. Focused words carry a LH*.

Because Tongan marks stress clearly with a pitch accent, along with other suprasegmental cues, like greater amplitude, greater duration and different voice quality, and because word edges are marked with AP-final edge tones, Tongan classifies as both a head- and edge-marking language (Jun 2012). It is another language in an increasing list of dual marking languages, like Bengali, Georgian, Tamil, Farsi and others.

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Appendix: Summary of the ToBI for Tongan

Tones/Breaks	Description
Pitch accents	
LH*	rise from low up to peak accent; the most common pitch accent
L*	low accent with slight fall at the end; appears on the last stressed syllable of an IP
Boundary tones	
La	low accentual phrase boundary
Ha	high accentual phrase boundary
L%	low intonational phrase boundary; end of declaratives and *wh*-questions
H%	high intonational phrase boundary; high boundary tone in the middle of a sentence followed by a pause
^H%	upstepped high intonational phrase boundary; end of yes/no questions and echo questions
LH%	low followed by rise to high at end of a phrase; continuation contour in the middle of a sentence
Break indices	
0	Reduced/encliticized boundary; weaker than word boundary
1	Word boundary
2	AP boundary
4	IP boundary
2-	Mismatch between 1 and 2 (either break index of 1 but has an AP boundary tone or break index of 2 but has no AP boundary tone)
3	Mismatch between AP and IP juncture (either perceive 2 with unexpected tonal marker or lengthening which are suitable for break index of 4 or vice versa)
p	Perceived hesitation or disfluency