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A Preliminary Model of Malagasy Intonation

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A Preliminary Model of Malagasy Intonation

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by

Jacob Bentley Aziz

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ABSTRACT OF THE THESIS

A Preliminary Model of Malagasy Intonation

by

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Master of Arts in Linguistics

University of California, Los Angeles, 2020

Professor Sun-Ah Jun, Chair

This thesis introduces a preliminary model of Malagasy intonational phonology under the framework of Autosegmental-Metrical phonology. The data covers declarative and interrogative sentences (yes/no and wh-), produced by five Malagasy speakers from the central highlands of Madagascar. The results show that Malagasy has two prosodic units marked by intonation: the Intermediate Phrase (ip) and the Intonational Phrase (IP). The ip corresponds to major syntactic constituents such as the predicate and the subject and is demarcated with a rising pitch accent (L+<H*) on its rightmost stressed syllable. The IP corresponds to the whole sentence and its right edge is marked with a non-prominent pitch accent (l+<h*) and a boundary tone. The thesis also identifies various allotones of pitch accents depending on the lexical tone type on the tonic and post-tonic syllable and the proximity of the following tone.

The thesis of Jacob Bentley Aziz is approved.

Kie Ross Zuraw

Edward L. Keenan

Sun-Ah Jun, Committee Chair

University of California, Los Angeles

2020

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1. Introduction

In this paper, I will present a preliminary analysis of the intonation of Malagasy under the Autosegmental-Metrical (AM) framework. Malagasy, an Austronesian language spoken in Madagascar, has been noted to have a close relationship between syntactic and prosodic constituents marked with intonation. Early descriptions of Malagasy intonation (e.g., Dahl, 1952) describe how major syntactic constituents such as the predicate and the subject form "intonation groups" that are each marked with an accent. More recent Autosegmental-Metrical analyses (e.g., Barjam, 2003; Frascarelli, 2010; Aziz & Paul, 2019) identify this accent as a pitch accent, appearing on the rightmost stressed syllable of certain syntactic constituents.

However, the few studies that exist on Malagasy in the AM framework are somewhat contradictory: while Barjam (2003) and Aziz and Paul (2019) identify a pitch accent (L+H*) on both the predicate and subject, Frascarelli (2010) claims that there is a pitch accent (L*+H) only on the predicate. Each of these three studies was limited in several ways, including the number of sentence types, tokens, and participants (i.e., one or two speakers) used in data collection. As a result, a more thorough analysis of Malagasy intonation is needed to fill these gaps; in the present research, I develop a preliminary model of the intonational structure of Malagasy by investigating simple and complex declaratives, wh- questions, and yes/no questions. The model is preliminary in that it is based on the data of five participants, does not cover a wide variety of syntactically complex sentences, and does not consider focus prosody. In the sections that follow, I focus on three main questions:

(1) What is the prosodic structure of Malagasy and which prosodic constituents are marked with intonation?

(2) How do these prosodic constituents relate to syntactic structure?

(3) What is the inventory of tones that mark these constituents, and what are their allotones?

In Section 2, I review the literature that is relevant to the discussion on Malagasy intonation including research on intonational theory and on the syntax, phonetics, and phonology of Malagasy. In Section 3, I discuss the methodology used in this research. In Section 4, I present my preliminary model of Malagasy intonation and the data that supports it. In Section 5, I discuss the phonetic realization of Malagasy pitch accents, and in Section 6 I discuss how intonation varies between different sentence structures. Finally, in Section 7, I discuss the implications of my model.

2. Literature Review

In this section, I will introduce the AM framework of intonational theory and Malagasy grammar in order to provide background for the present research and to motivate the research questions.

2.1 The Autosegmental-Metrical Model of Intonation

The intonation model proposed in this paper is based on tonal categories and prosodic constituents in Malagasy, analyzed under the Autosegmental-Metrical (AM) framework of intonational phonology (Pierrehumbert, 1980; Beckman & Pierrehumbert, 1986; Ladd, 2008). The AM framework defines intonation as a linear sequence of high (H) and low (L) tonal targets and their combinations. These tonal targets are generally considered to have two functions: marking prominence or marking prosodic constituents. In a language with lexical stress, prominence is marked by *pitch accents* realized on stressed syllables; *boundary tones* are used to mark the edge of prosodic constituents and are generally realized on a syllable at or near the prosodic phrase boundary. Pitch accents can be either a singleton (e.g., H*) or a bitonal (e.g.,

L*+H), with an asterisk on the tone realized on the stressed syllable (e.g., L+H* for a rising pitch accent with a H tone on the stressed syllable immediately preceded by a L tone). Boundary tones can mark the left or the right edge of a prosodic unit, and after a boundary tone, a diacritic is added referring to the prosodic unit they are associated with. For example, after an Intonational Phrase (IP) boundary tone, a percentage sign (%) is added (e.g., L% for an IP-final low boundary tone), and after an Intermediate Phrase (ip) boundary tone, a minus sign (-) is added (e.g., L- for an ip-final low boundary tone).

While the AM model analyzes intonational contours using two underlying tonal targets, H and L, various surface realizations of H and L tones can be explained by using phonetic rules such as downstep and upstep in American English intonation (Beckman & Pierrehumbert, 1986). However, when the ToBI (Tones and Break Indices) transcription system was developed for American English, diacritics were introduced to mark surface tonal targets and a tonal alignment with a text (Beckman & Hirschberg 1994, Beckman et al. 2005). For example, '!' was added before a H tone to mark a downstepped H tone (e.g., !H*, !H-) and '<' or '>' were used to mark a delayed or early tonal alignment, respectively, relative to the host syllable. This convention has been adopted to the ToBI system of other languages. For example, for tonal targets realized higher than a typical H tone target (i.e., upstep) in a certain context, '^' was used in German ToBI (Grice et al. 2005) but '¡' was used in Spanish ToBI (Beckman et al. 2002, Prieto & Roseano 2010).

In this paper, tonal labels and diacritics are chosen to reflect surface tonal variations and alignments, and a new tone symbol was created to reflect a weak degree of prominence. This was necessary to distinguish allotonic variations across pitch accents, reflecting unique intonational properties of Malagasy.

2.2 Syntax of Malagasy

In order to discuss the relationship between prosodic and syntactic constituents, I will first outline the most important and relevant details pertaining to Malagasy syntax and word order.

2.2.1 Declarative Syntax

The basic word order in Malagasy is verb-object-subject, sometimes referred to as predicate-initial, as shown in (1).

(1)	[$_{Pred}$ Nijery	ny	ranomasina]	[$_{Subj}$ ilay		lehilahy][1]
	Pst.AT.watch[2]	DET	sea		DET	man

'The man watched the sea'

In the present dataset, there are two types of complex declaratives: sentences with clausal complements, and sentences with relative clauses. Unlike simple declaratives, clausal objects do not appear immediately after the verb. Instead, it appears sentence-finally, as in (2). As with surface VOS order, there are several possible derivations for this word order, the details of which are not important here, except for the assumption that the clausal object is base-generated as the complement to the verb and it is extraposed to a position to the right of the subject (as argued for in Edmiston & Potsdam (2016)). This detail is important as it presumes that in sentences like (2),

[1] Many thanks to Clodia Rambinintsoamaharavo, Manoa Ndrantoarisoa Andrianalizaha, and Dr. Baholy Ralalaoherivony for their help in creating the Malagasy examples throughout this paper

[2] Malagasy has a voicing system similar to other Austronesian languages, where the verb morphology reflects the thematic role of the subject.

AT: Agent Topic (the subject is an Agent)
TT: Theme Topic (the subject is a Theme)
CT: Circumstantial Topic (the subject has another thematic role)

the verb alone, independent of its extraposed clausal complement, forms the predicate in the surface form.

(2) [$_{Pred}$ Mitaraina] [$_{Subj}$ i Mamy] [$_{CP}$ fa [$_{Pred}$ mila azy] [$_{Subj}$ ny namany]

AT.complain Mamy COMP AT.need it DET his friend

'Mamy complains that his friend needs it'

Relative clauses may adjoin to a subject noun phrase. The relative clause, which optionally begins with the relative pronoun *izay*, immediately follows the noun phrase that it modifies. All relative clauses in Malagasy are subject relative clauses, and consequently they may only contain non-subject arguments (Keenan, 1976). An example appears in (3).

(3) [$_{Pred}$ Mila azy] [$_{Subj}$ ny namany izay mihinana mananasy]

AT.need it DET his friend REL AT.eat pineapple

'His friend who eats pineapple needs it'

2.2.2 Yes/No Questions

Malagasy yes/no questions are formed with the particle *ve*, as in (4)

(4) Mila azy ve ny namany

AT.need it Q DET his friend

'Does his friend need it?'

Paul (2001b) argues that *ve* is a second-position clitic that attaches to the right of the leftmost syntactic phrase; in most cases, because of Malagay's VOS word order, this means that *ve* is attached to the predicate, and in the present data set, this is true of all instances of *ve*. Additionally, she proposes that *ve* is a syntactic head, and not a phrase.

2.2.3 Pseudoclefts and Wh- Questions

In Malagasy, focus can be derived syntactically by positioning the focussed element at the beginning of the clause before the focus particle *no*, shown with a noun phrase in (5) and an adverbial in (6).

(5) Ny namany no mila azy
DET his friend FOC AT.need it
'It is his friend who needs it'

(6) Anio alina no halaina aminao ny fanahinao
tonight FOC Fut.take.TT from you DET your soul
'It is tonight that your soul will be taken from you' (Luke 12:20, Malagasy Bible)

Paul (2001a) argues that sentences with this structure are actually pseudoclefts, where the focussed element [ny namany] is the predicate and the following clause [no mila azy] is a headless relative clause that acts as the syntactic subject. In this sense, the structure of the sentences in (5) and (6) is no different from other declaratives and should still be considered to be predicate-initial.

Potsdam (2006) extends this analysis to wh-questions, arguing that the structure is essentially the same as pseudoclefts, with the wh- word in the predicate position, followed by a *no* clause that acts as the syntactic subject. For most wh- questions, the verb must agree with the thematic role of the wh- word (e.g., in the question *Who needs it?*, the wh- word *who* is the Agent, so the verb must have Agent Topic morphology). This is shown in (7).

(7) Iza no mila azy
who FOC AT.need it
'Who needs it?'

However, adverbial wh- words such as *when* and *where* do not necessarily have the same syntactic structure as other wh- questions; whereas other wh- words must agree with the verb of the following *no* clause, for most adverbial wh- words this is optional, and leaving a full VOS clause after the particle *no* is perfectly acceptable. For the wh- word *nahoana* 'why', this is not optional, and the verb must always agree with a noun other than the wh- word:

(8) Nahoana no mila azy ny namany
why FOC AT.need it DET his friend
'Why does his friend need it?'

2.3 Phonetics and Phonology of Malagasy

2.3.1 Segmental Phonetics and Phonology

Central dialects of Malagasy have five phonemic vowels, /a, e, i, o, u/ (Howe, 2019). There are various allophones for each that are not particularly relevant here; notably, however, some unstressed vowels are deleted or devoiced.[3] Howe (2019) argues that these vowels are never deleted, only devoiced, and states that acoustic and airflow data suggest the presence of a vowel. In my dataset, however, there are tokens where the acoustic data indicates a complete deletion of the vowel. The result is that multisyllabic words may be realized as a single syllable; for example, *olona* 'people', whose underlying representation is /u.lu.na/, is frequently produced as ['uln] by my speakers.[4]

Central Malagasy also has 31 consonant phonemes, including 12 homorganic voicing pairs (Dahl, 1952; Howe, 2019). Cross-linguistically, it is common for changes in pitch to accompany a voicing contrast, where the onsets of vowels following voiceless segments tend to have higher F0 than those following voiced segments, known as microprosody (Hombert et al., 1979). This effect has been observed in Malagasy, and Dahl (1952) and Rakotofiringa (1982) argued that pitch differences between voiced and voiceless consonants in Malagasy is purely a phonetic consequence of voicing. In contrast, however, Howe (2017) presents data from speakers of Central Malagasy, in and around the capital of Antananarivo, where my speakers are from, and argues that in this dialect, the voicing contrast has been nearly neutralized toward devoiced, leaving pitch distinctions as the primary phonetic cue to underlyingly voiced vs. voiceless obstruents. In stressed, pitch-accented syllables, the vowel following underlyingly voiceless obstruents (e.g., /f/ and /s/) reaches a relatively high F0 plateau before falling slightly, while

[3] Vowel deletion and devoicing in Malagasy is not well studied, so the exact environment where this occurs is not clear; however, there is deletion and/or devoicing of unstressed vowels in both the word-internal and word-final position.

[4] I use the word *underlying* to refer to the pronunciation predicted by the orthography, as described in dictionaries (e.g., Richardson, 1885). It may also be referred to as the *historical* pronunciation of the word, then, though variation in which vowels are deleted reveals that all or most deleted vowels must be present in the underlying form.

vowels following underlyingly voiced obstruents have a rising F0 during the vowel and may show an F0 "dip" preceding the rise, depending on the amount of phonetic voicing. In unstressed syllables and stressed syllables in words not bearing a pitch accent, Howe finds that all consonant types result in a falling contour in the following vowel, but that the average F0 is higher following underlyingly voiceless obstruents compared to voiced.

In stressed, accented syllables, the average difference in the F0 of the first half of the vowel following voiceless vs. voiced obstruents was found to be 4.97 semitones, similar to the range in F0 documented in other tone languages. Based on this large difference in F0 between underlyingly voiced and voiceless obstruents, and based on the fact that Central Malagasy speakers realize this F0 difference regardless of the level of phonetic voicing (indicating that pitch differences are not simply a biomechanical consequence of vocal fold vibration), Howe concludes that pitch is the primary phonetic cue of voicing, and thus Central Malagasy constitutes a language with lexical tone. This fact will be important to consider in the analysis of Malagasy intonation.

2.3.2 Word Stress

Malagasy has stress, which I take to be post-lexical. The most common surface position for primary stress is on the penultimate syllable, though there are several exceptions. First, many words ending in <na>, <ka>, and <tra>, sometimes called "weak" syllables, surface with antepenultimate stress (Dahl, 1952; Erwin, 1996). Some authors (e.g., Albro, 2005) argue that stress is in fact regular and post-lexical, and that the antepenultimate stress that arises in words with weak syllables is because the final syllable contains an epenthetic vowel that is excluded from stress assignment. In other words, primary stress is assigned to the penultimate syllable of

the underlying form and does not shift when a vowel is epenthesized. As a result, minimal pairs exist at the surface level, such as *lalana* ['la.la.na] ‘road’ and *lalàna* [la'la.na] ‘law’.

Further, there are a number of words with final stress. Many words ending in /e/ (e.g., *ome* [u'me] ‘gift’), loanwords (*sokolà* [su,ku’là] ‘chocolate’), words ending in certain clitics, such as the second-person singular genitive *-ao* (e.g., *namanao* [na.ma'no] ‘your friend’), among others, bear stress on the final syllable. Finally, as described above in 2.3.1, some unstressed vowels are frequently deleted or devoiced; when word-final vowels are deleted, this leaves the onset consonant to be the coda of the preceding syllable, and consequently, underlyingly penultimate stress appears on the final syllable of the surface form.

The acoustic correlates of stress are less-well studied, though we can look to a few studies that have investigated this. Earlier studies such as Rakotofiringa (1981) and Raoniarisoa (1990) highlight the relationship between stressed syllables and a rise in pitch, though as Raoniarisoa notes, this rise in pitch does not appear on all stressed syllables and can more accurately be described as a feature of Malagasy intonation. Howe (2017) explicitly investigates other acoustic cues of stress and finds that an increased duration is a significant indicator of stress. Additionally, she shows that there is significantly less voicing on the onset of stressed syllables compared to unstressed syllables, but that this effect is only present when the stressed syllable onset is an oral obstruent and when the syllable bears a pitch accent. However, Howe did not investigate any relationship between stress and intensity.

To summarize, Malagasy is a language with post-lexical stress that can be realized on the final, penultimate, or antepenultimate syllable, depending on the lexical item. The primary acoustic feature associated with stressed syllables is increased duration, though other features such as a rise in f0 and decreased voicing is associated with prominent syllables at the post-

lexical level. In my analysis of Malagasy intonation in Sections 4 through 6, I will further expand on the relationship between intonation and stress, so the details in this section are particularly relevant.

2.3.3 Intonation

In the past, a small number of researchers have investigated the intonation of Malagasy, focussing mostly on the close relationship between prosodic and syntactic constituents. In particular, it has been observed that in declarative sentences, both the predicate and the subject correspond to prosodic phrases. In one of the earliest descriptions of Malagasy intonation, Dahl (1952) describes the predicate and the subject as belonging to independent "accent groups," each of which bears an accent. He finds that in declarative utterances, the final tone is lower than the preceding tone, while in interrogatives, the final tone is higher. Rafitoson (1980) similarly concludes that the predicate and subject form groups that are marked with "accents," though she argues that adverbs may also form their own accent groups.

More recently, a handful of studies have investigated Malagasy intonation under the Autosegmental-Metrical (AM) framework. Frascarelli (2010) primarily looks at the syntax-prosody interface as it pertains to information structure, but also discusses some of the intonational properties of Malagasy. In simple declaratives, Frascarelli identifies a single pitch accent, L*+H, which appears on "the constituent preceding the subject;" i.e., the predicate. She also examined pseudoclefts and wh-questions, which share a similar syntactic structure (as described in 2.2.3). Here, Frascarelli observes a rising pitch accent that she labels H* on the focussed element, which corresponds to the predicate in Paul's (2001a) analysis.[5]

[5] In the f0 tracks provided in her paper, the contour of the H* pitch accent that Frascarelli describes resembles the rising pitch accent that she previously labels L*+H.

Barjam (2003) offers a more complete analysis of Malagasy under the AM model, focussing on simple declaratives, declaratives with clausal complements, and declaratives with relative clauses. In contrast to Frascarelli (2010), Barjam argues that both the subject and the predicate are marked at their right edge with a L+H* pitch accent; that is, a rising tone is observed on the stressed syllable of the rightmost word in both syntactic constituents. Additionally, he finds that declarative sentences are marked with a low (L%) boundary tone at the right edge. Barjam also looks at complex declaratives with embedded clauses and finds that the intonation of these sentences resembles that of two simple declaratives; that is, the matrix verb and subject are each marked with an L+H* pitch accent, as are the embedded predicate and subject. However, Barjam argues that only one boundary tone appears in these sentences, indicating that the entire sentence forms an Intonational Phrase (IP). Finally, Barjam looks at relative clauses, which he describes as similar to simple declaratives: the predicate is marked at its right edge with L+H*, as is the subject, including the entire relative clause. According to him, then, in declaratives with a relative clause, the relative clause is not marked by any additional pitch accent, unlike declaratives with a clausal complement, where the clausal complement itself receives two pitch accents.

Barjam (2003) also discusses the phonetics of some of these tonal categories. First, he observes that if the final pitch accent appears at the right edge of the IP, the following low boundary tone does not have the space to be realized and is consequently truncated. Regarding pitch accents, Barjam notes several pitch accents whose high or low targets are not fully realized. According to his data, Malagasy shows declination across the utterance, where each high target is realized with a pitch that is low relative to the preceding high. Additionally, Barjam observes instances of tonal crowding that results in the undershooting of some low targets. In particular,

when two L+H* pitch accents are separated by fewer than two unstressed syllables, Barjam argues that the second pitch accent is realized as H*, resulting in a high plateau from the first pitch accent to the next.

In Howe's (2019) synthesis on the phonetics of Malagasy, she presents some additional data that gives insight into the realisation of the pitch accent when it interacts with lexical tone. She notes that when a low lexical tone follows a pitch-accented syllable, the high peak of the rising pitch accent is realized *within* the stressed syllable; elsewhere, however, the high peak of the pitch accent appears on the syllable *following* the syllable; this is true both when the pitch accent is followed by a high lexical tone or no tone at all.

Finally, it is worth noting one perception study that may help us to understand the phonological nature of the tonal events that exist in Malagasy. Raoniarisoa (1990) conducted a perception experiment in which native speakers of Malagasy listened to declarative sentence and were asked to identify which syllables they perceived as prominent. In most sentences, participants identified the stressed syllable at the right edge of the predicate as prominent, but not the stressed syllable of the subject. While this supports Frascarelli's (2010) finding of a single pitch accent in Malaglasy declaratives, on the predicate, it does not refute Barjam's (2003) observation of a pitch accent on the syntactic subject; it is possible that the syllables perceived as prominent by naive Malagasy speakers in Raoniarisoa's (1990) work could be those receiving a nuclear pitch accent, instead of a pitch accent, as observed in the studies on the perception of prominence in English (e.g., Cole et al., 2010; Bishop 2012). I will explore the nature of this pitch event in the following sections.

To conclude, while there have been several individual studies investigating intonation in Malagasy, there remains a need for a complete analysis of Malagasy under the Autosegmental-

Metrical framework. First, the results of these existing studies are in conflict with one another, with some authors arguing for a pitch accent only on the predicate (e.g., Frascarelli, 2010 and Raoniarisoa, 1990), while others argue that both the predicate and the subject are marked with a pitch accent (e.g., Barjam, 2003 and Rafitoson, 1980). The preliminary model presented in this study will allow us to reconcile these conflicting results. Second, several aspects of Malagasy intonation have been ignored, prohibiting us from drawing any conclusions about the overall prosodic structure of Malagasy. In particular, these existing studies have not investigated yes/no question intonation, and where they include wh- questions, important details are missing, such as information on boundary tones. Additionally, previous studies have not gone into detail about the phonetic realisation of tonal events, such as the interaction of lexical tone and intonation in Malagasy. In the sections that follow, I show evidence for several allotonic variants of Malagasy pitch accents and boundary tones. Finally, the two Malagasy studies under the AM framework, Frascarelli (2010) and Barjam (2003), each included only a single consultant and a small number of total utterances. By including 84 sentences spoken by five participants (a total of 420 tokens), the present study is the largest in the AM framework to date. The present study aims to address these problems with previous research in developing a preliminary model of Malagasy intonation.

3. Methods

3.1 Data

The data set consists of 84 utterances by five speakers (total: 420 tokens) that were elicited in a reading task. The sentences were created with the primary intent of manipulating sentence structure and type; each sentence was either a simple declarative, declarative with clausal complement, declarative with relative clause, declarative with syntactic focus by

pseudoclefting, yes/no question, wh- question, or wh- in situ. Within each of these general categories, the length of each major syntactic constituent was manipulated, both in terms of phonological length and the number of syntactic subconstituents. Predicates variably consisted of only a verb or adjective, a verb with one or two object complements, and a verb with an adverb, while subject noun phrases consisted of either a pronoun, a determiner and a noun, and an optional adjective or relative clause. For example, the subject noun phrase was as short as one word (e.g., *izy* ['iz] 'he') or as long as five (e.g., *ny namanao izay manana milinao* [nna.ma'no 'zaj 'ma.na.na 'mil.nạ̊] 'your friend who owns machinery').

3.2 Participants

Each of the five participants included for this preliminary model was a male, university-aged speaker of the Merina dialect of Malagasy. This dialect, spoken in the capital city of Antananarivo and surrounding areas, was chosen as it is the basis for the standardized variety of the language, Official Malagasy. Because the Merina dialect is one of the varieties spoken in Central Madagascar, all participants exhibited the lexical tone contrast described in 2.3.1. All participants had been living in Antananarivo at the time of recording and were bilingual in Malagasy and French.

3.3 Analysis

Data were analysed using *Praat* (Boersma & Weenink, 2017); both pitch (f0) and intensity were tracked throughout each utterance. To begin, I identified the points in each utterance where pitch changed and assigned a phonetic tonal label that incorporated relative high and low points in the f0 (e.g., L+H for a rise in pitch within a single syllable, or L for a low target or at the f0 inflection point from falling pitch to the onset of a low plateau over several syllables). Then, each pitch event was categorized as either a pitch accent or a boundary tone

based on its location relative to the stressed syllable or the edge of a phrase, acoustic realizations (e.g., f0 peak alignment), and the syntactic structure of the utterance. Finally, phonological category labels were assigned over multiple phonetic realizations by identifying the factors determining the allophonic distribution of the tonal categories and the frequency of the occurrence of the surface tonal category.

4. A Preliminary Model of Malagasy Intonation

In this section, a preliminary model of Malagasy intonation is proposed within the Autosegmental-Metrical framework, using pitch track figures to support the model. First, I will outline the general prosodic structure of Malagasy and the ways in which Malagasy marks prosodic constituents with intonation. Then, I will discuss how Malagasy intonation varies between different sentence structures, starting with simple and complex declaratives before moving to wh- and yes/no questions.

Figure 1 outlines the proposed model of intonational phonology of Malagasy. In creating this model, I aimed to incorporate the most important facts about Malagasy prosodic structure and the ways that it is marked with intonation. First, the highest prosodic unit defined by intonation is the intonational phrase (IP), which is marked by a boundary tone (L%) and is commonly accompanied by the non-prominence of the IP-final pitch accent (identified in the current model by using lowercase letters, e.g., l+<h*). Each IP is made up of at least one intermediate phrase (ip)[6], which corresponds to a major syntactic constituent, including the predicate, the subject, and any predicate-external adverbial. Each ip is marked with a rising pitch accent (typically L+<H*, but L+<¡H* on the final ip of questions), realized on the rightmost stressed syllable of the constituent. IP-medial intermediate phrases are also marked with a low

[6] I assume that it is possible for an IP to consist of a single ip (e.g., a single word utterances like *Manahoana* 'Hello,' though the present dataset does not include any IPs of this type.

boundary tone (L-) which is not realized when there are not enough syllables before the following pitch accent.

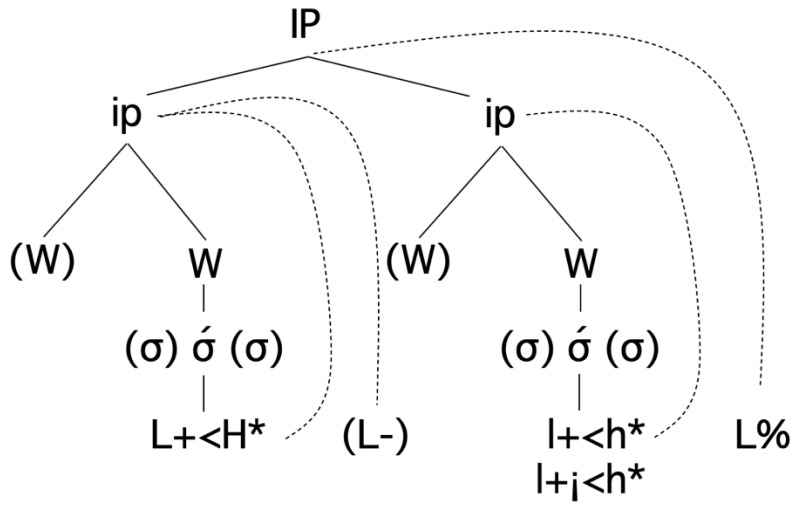

Figure 1. Model of Malagasy intonation

4.1 Prosodic Structure

4.1.1 Intonational Phrase

The highest prosodic unit marked by intonation in Malagasy is the intonational phrase (IP). Based on the present dataset, each IP is marked with a L% boundary tone at its right edge; L% is realized on the IP-final syllable as a fall in f0 following the phrase-final pitch accent. When the final pitch accent is on the penultimate or antepenultimate syllable of the IP at the surface level (taking into account that the underlying word-final vowel is often deleted or devoiced), L% is fully realized. An example of L% is shown in Figure 2. However, the L% boundary tone is often truncated, leaving f0 to end at the high point of the final pitch accent when the final pitch accent falls on the final syllable of the utterance at the surface level, leaving no space for the low boundary tone to be realized, as in Figure 3. This indicates that in the realization of Malagasy intonation, pitch accents take priority over boundary tones when resolving tonal crowding.

Additionally, intonational phrases are commonly marked with non-prominence of the IP-final pitch accent, and sometimes even no pitch accent is found IP-finally, as shown in Figure 4. Out of a sample of 154 simple declarative utterances, 18 (12%) had no pitch accent on the IP-final word, and of these, half (50%) were either a pronoun or the word *olona* ‘people’. Where there was a pitch accent present, in approximately two-thirds of these cases, the IP-final pitch accent lacked acoustic prominence. The phonetics of these non-prominent pitch accents is described in more detail in Section 5.

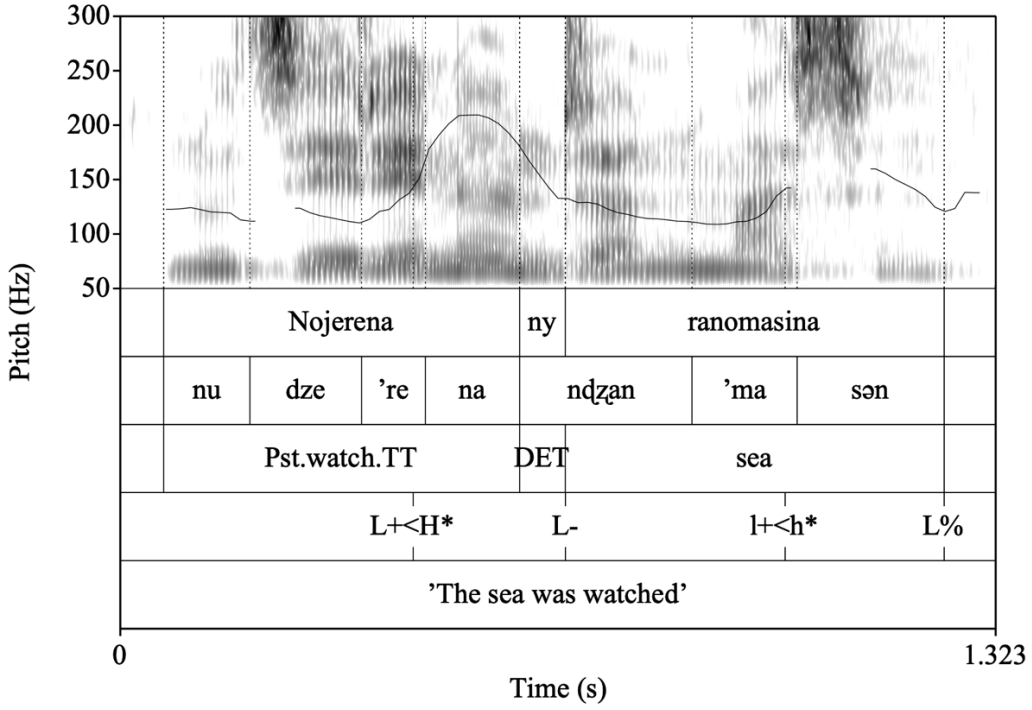

Figure 2: f0 track of *Nojerena ny ranomasina* ‘The sea was watched’ showing a low IP-final boundary tone (L%) and a single word predicate, *nojerena* ‘was watched’ bearing a pitch accent

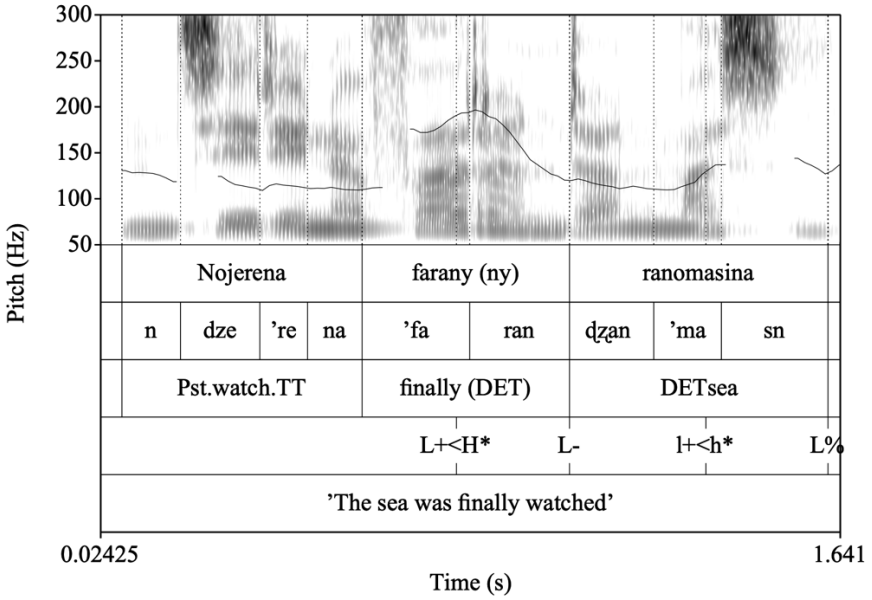

Figure 3: f0 track for *Nojerena farany ny ranomasina* 'The sea was finally watched' showing a truncated IP-final boundary tone (%) and the final word of a multi-word predicate, *farany* 'finally', bearing a pitch accent

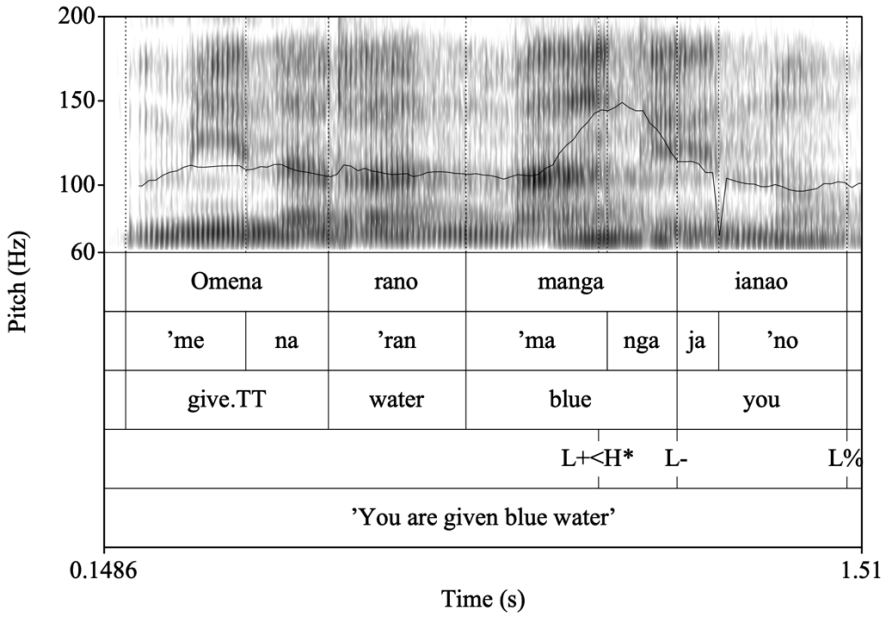

Figure 4: f0 track for *Omena rano manga ianao* 'You are given blue water' showing a subject NP, in this case the pronoun *ianao* 'you', which lacks a pitch accent

In these figures, the first tier is for words as they are written in the orthography, which roughly corresponds to a phonemic representation[7]; the second tier is the phonetic tier, divided by surface syllables; the third tier is an English gloss; the fourth tier is the tones tier where pitch accents are labeled within the pitch accented (i.e., stressed) syllable (specifically a H*-type pitch accent is labeled on the f0 maximum point and a L*-type pitch accent is on the f0 minimum point within the syllable), but the ip-boundary L- tone is labeled at the actual f0 point where a L target is visible, thus not always aligned with the end of a syntactic constituent. The fifth tier is an English translation of the entire sentence. The same format will be used for all pitch track figures in the paper.

4.1.2 Intermediate Phrase

Below the level of the intonational phrase is the intermediate phrase (ip). According to my analysis, Malagasy intermediate phrases correspond to major syntactic phrases. In a VOS declarative sentence, an ip corresponds to the predicate phrase, the subject noun phrase, and any predicate-external adverb phrases. Similarly, in pseudocleft constructions, which are commonly used for focus, the focussed noun phrase forms one ip, while the following clause, beginning with *no,* forms another. As Paul (2001a) describes, the focussed NP is in fact the syntactic predicate, while the *no* clause is the subject; since both form intermediate phrases, the prosodic structure of pseudoclefts is not different from that of simple declaratives. An example of a pseudocleft appears in Figure 5.

[7] There are some exceptions to the orthography-phoneme correspondence such as <y>, which corresponds to /i/, and <o>, which corresponds to /u/.

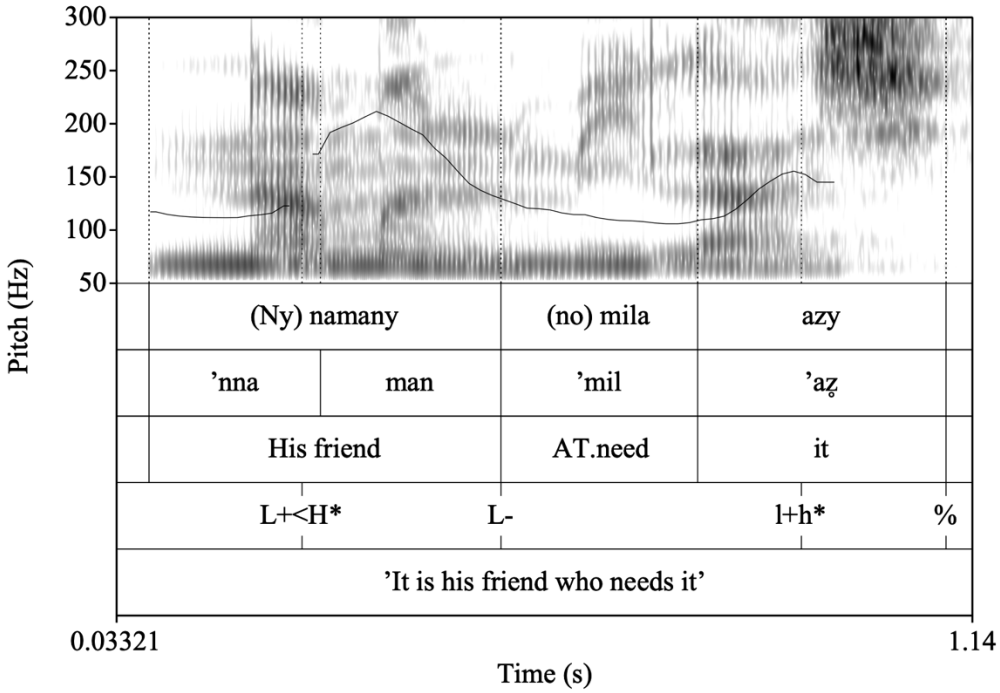

Figure 5: f0 track for *Ny namany no mila azy* 'It is his friend who needs it', showing an ip boundary after the focussed NP in a pseudocleft sentence. Note the focus marker [no] is not realized on the surface

Each intermediate phrase is marked with a rising pitch accent on the rightmost word of the constituent. That is, the stressed syllable of whichever word appears in the phrase-final position bears this pitch accent. This is true regardless of the length of the ip or the number of syntactic sub-constituents within the larger constituent that forms the ip; take, for example, a predicate that consists of just a single verb, as shown in Figure 2, compared with a predicate with an adverbial phrase, as in Figure 3.

I have labelled this ip-final pitch accent as L+<H*. In most cases, it is realized as a sharp rise in f0 during the stressed syllable, with the high peak realized on the following syllable. The pitch accent may be realized in different ways depending on phonological context, and

throughout this paper may be labelled as L*+H, L+H*, or others; a full description of the phonetics of these allotones appears below in Section 5.

In addition to the ip-final pitch accent, many sentence-medial intermediate phrases are marked at their right edges with a low boundary tone, labelled L-. This tone is realized as a fall in f0 following the ip-final pitch accent, landing near, but slightly higher than, the bottom of the speaker's pitch range at the end of the ip. L- is generally not present when one ip-final pitch accent closely precedes the following pitch accent; typically, L- appears if there is more than one syllable between the peak of the pitch accent and the onset of the next. That is not to say that there is no intermediate phrase boundary when L- does not appear; it is possible that there is an underlying L- whose low target is obscured by the low target of the following L+H*. I leave it to future perception studies to evaluate whether an underlying L- boundary tone is still present in these utterances and whether speakers identify the same degree of juncture when there is an L- or not.

Additionally, the position of the L- boundary tone may be delayed to a syllable following the syntactic constituent boundary. This occurs when L+<H* is realized with an f0 peak on the final syllable of the syntactic constituent or later, causing the L- target to be pushed to the syllable following the f0 peak, typically the first syllable of the following word. In Figure 6, for example, the word *inona* 'what' is realized as a single syllable [inn], with the peak of L+<H* being realized at the end of the syllable, labelled L+H*. Because the pitch accent peak is realized on the final syllable of the predicate, the L- boundary tone is realized on the following syllable, *ilay* [le].

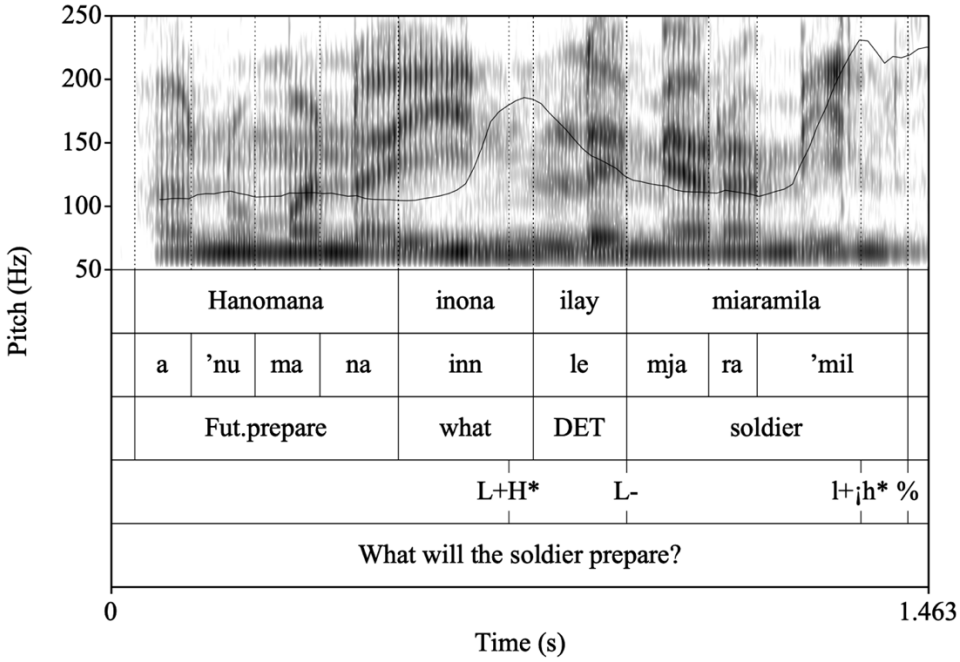

Figure 6: f0 track for *Hanomana inona ilay miaramila?* 'What will the soldier prepare?' showing that the realization of the pitch accent peak on the final syllable of a syntactic constituent delays the ip-final L- boundary tone to the following syllable

5. Pitch Accents

5.1 L+<H*

Based on the data analyzed for this paper, Malagasy has two distinctive pitch accent categories: a rising pitch accent with a delayed peak (L+<H*) and its upstepped version (L+<¡H*). The first type, L+<H* is the most common in Malagasy; its default f0 shape is a rise in pitch throughout the stressed syllable, reaching a peak on the post-tonic syllable. The peak can be as high or lower than preceding high peaks There are several variations of this pitch accent conditioned by different phonological contexts. These allotones of L+<H* pitch accent will be described in the following subsections. The second type, L+<¡H*, is described in Sec. 5.2 in more detail.

5.1.1 L+H*

There are two phonological environments in which the L+<H* pitch accent is realized as L+H*, where the peak is realized *within* the stressed syllable. The first of these environments is where the pitch accent is followed by a syllable with a low lexical tone. As described in 2.3.1, Malagasy is claimed to have contrastive lexical tone that is correlated with historical voicing (Howe 2017), and this is confirmed in my dataset: when a pitch accented syllable is followed by a syllable with an underlying voiced obstruent, thus lexically specified with a low tone, as in the word *azy* /'a.zi̥/, the f0 of the post-tonic syllable does not show a delayed peak of the preceding pitch accent. Instead, the f0 is depressed to a level below that of the preceding syllable, presumably due to the presence of the low tone, which results in an f0 peak *within* the stressed syllable. This contrasts with a pitch accented syllable followed by a lexically high-tone syllable (i.e., when the onset of the following syllable is a voiceless obstruent) as well as a syllable without any lexical tone (i.e., when the onset of the syllable is not an obstruent). In this case, the f0 peak of pitch accent is realized on the post-tonic syllable. This result is consistent with Howe's (2019) observation that pitch accent peak is realized within the stressed syllable only when followed by a low lexical tone. An example of L+H*, realized before a syllable with a low lexical tone, and L+<H*, realized before a syllable with a high tone and one without lexical tone, are shown in Figures 7, 8, and 9, respectively.

L+H* is also realized when the vowel of the post-tonic syllable is deleted. As described in 3.2.1, unstressed vowels are frequently deleted in Malagasy, and when this happens, the onset of that syllable is realized phonetically as the coda of the preceding syllable. Thus, while the peak of L+<H* remains aligned to the underlyingly post-tonic syllable, on the surface it is

realized within the stressed syllable. In Figure 10, below, the first two syllables of a multisyllabic word are reduced to one syllable and the resulting pitch accent is the L+H* allotone.

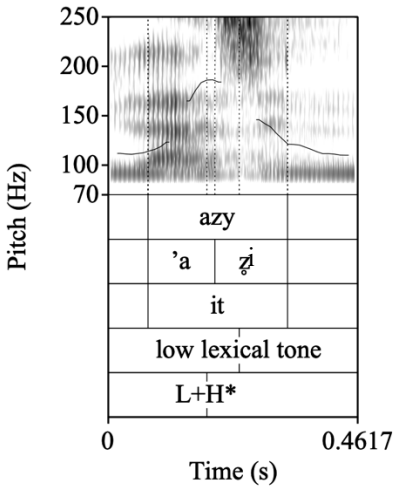

Figure 7: L+H* preceding a low lexical tone

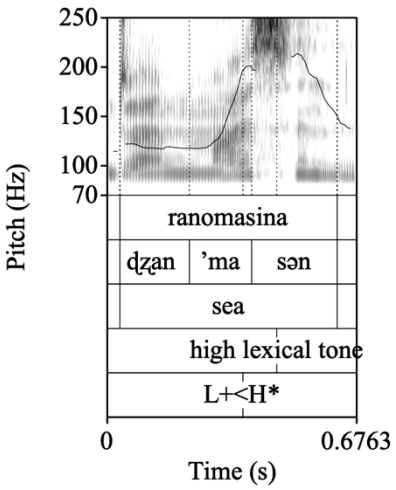

Figure 8: L+<H* preceding a high lexical tone

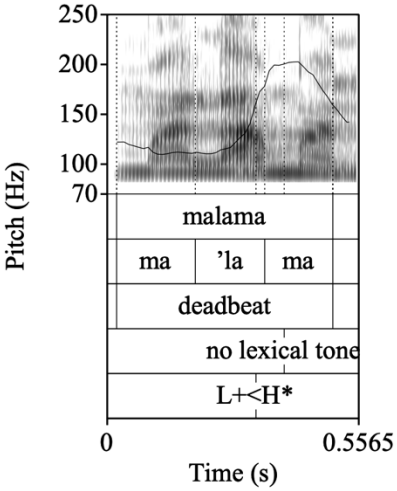

Figure 9: L+<H* preceding a syllable without lexical tone

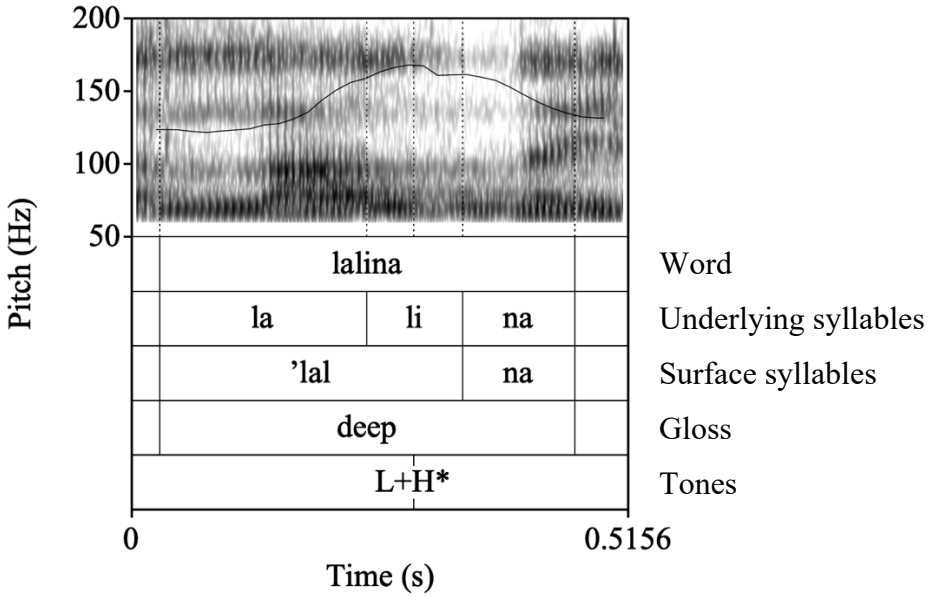

Figure 10: L+H* realized when a multisyllabic word is reduced

5.1.2 L*+H

The L*+H allotonic variant of L+<H* is realized in two phonological contexts. The first of these environments is where a pitch accented syllable also has a low lexical tone. According to Howe (2017), stressed, accented syllables that bear a high tone have a high f0 plateau before falling slightly, while those pitch accented syllables that have an underlying voiced obstruent onset show a small F0 dip at the onset of the vowel, followed by a rise. My results are in agreement with Howe (2017). Like her, I observe the high plateau or shallow rise on accented syllables with a high lexical tone (Figure 11) and the F0 dip and rise on accented syllables with a low lexical tone (Figure 12), which I have labelled L*+H.

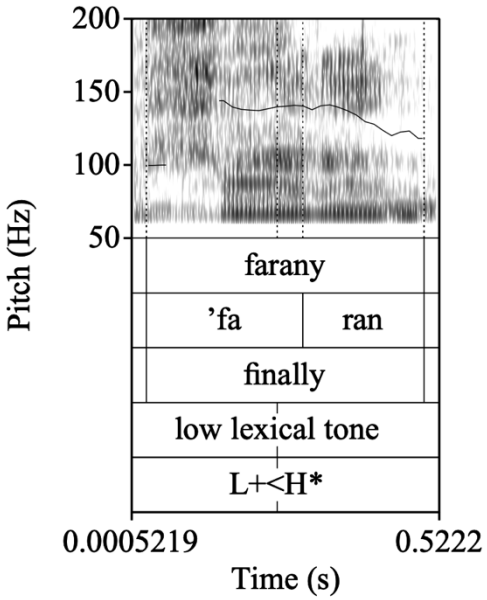

Figure 11: Pitch accent on a syllable with a high lexical tone

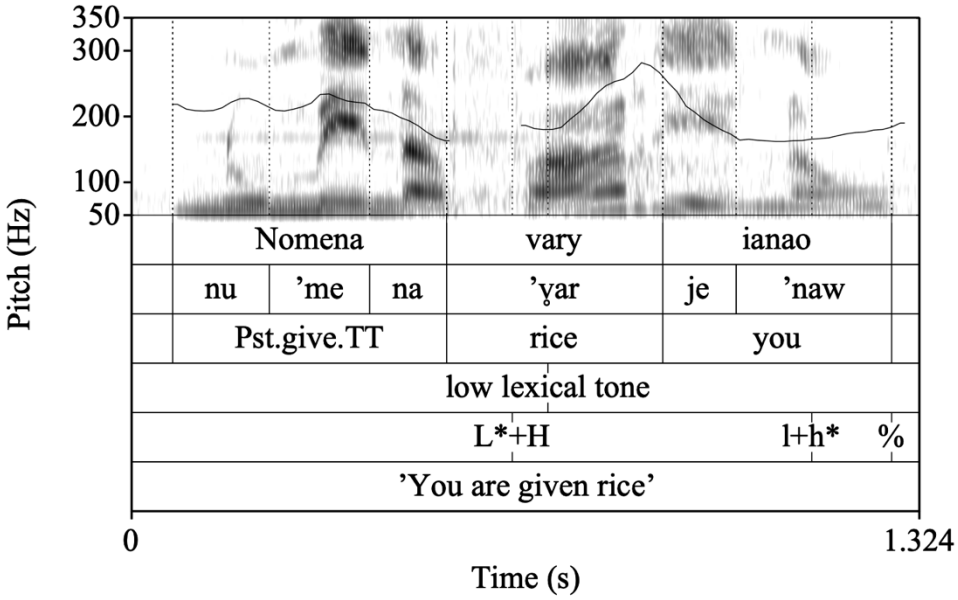

Figure 12: Pitch accent on a syllable with a low lexical tone[8]

L*+H may also appear when closely follows another pitch accent, typically with one or two intervening syllables. Presumably, there is not enough time to realize the low target of L+<H* before the stressed syllable, so f0 interpolates from the preceding H tone target down toward the stressed syllable. Similarly, L*+H appears when the pitch accent is early in the IP, typically in the first word; in this case, I assume that Malagasy speakers start each IP in the middle of their pitch range and do not have enough time to lower f0 to the low target before the onset of the stressed syllable. An example of L*+H both at the beginning of an IP and closely following another pitch accent is in Figure 13 on the words *homanina* 'will be given' and *anio alina* 'tonight'.

[8] This example comes from a separate dataset, from Aziz & Paul (2019)

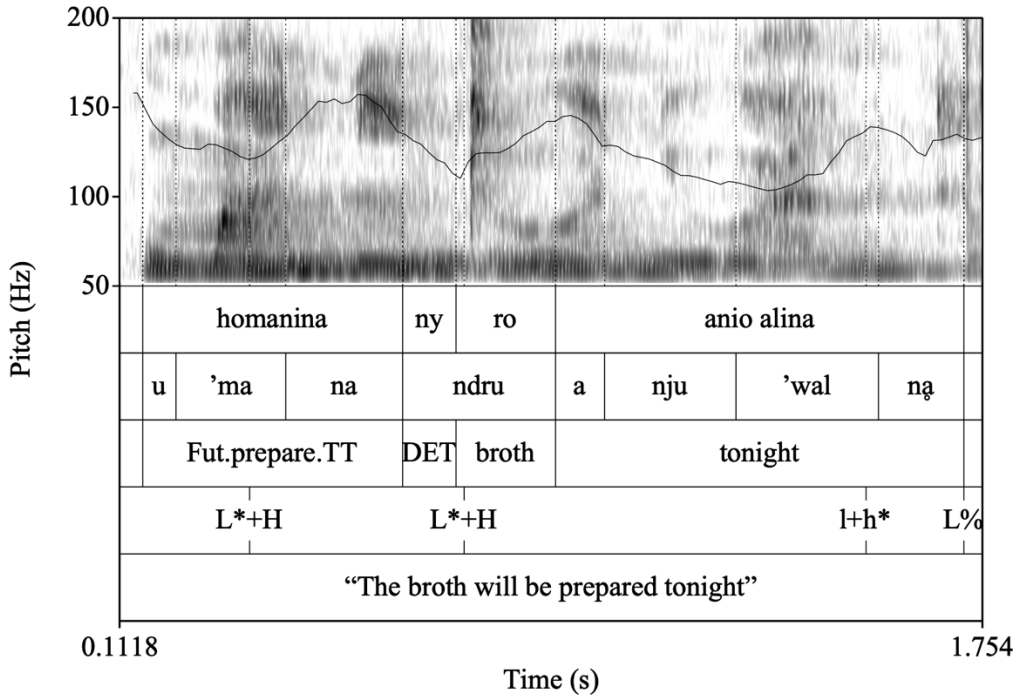

Figure 13: f0 track for *Homanina ny ro anio alina* 'The broth will be prepared tonight' showing the L*+H allotone on the word *homanina*, which is the first word in the IP, and on the word *anio alina*, which closely follows the preceding pitch-accented syllable

5.1.3 Non-prominent Pitch Accents

As described in 2.1.1, the function of pitch accents in the Autosegmental-Metrical framework is to mark prominence, and in a language that has stress, prominence is often cued by acoustic properties such as intensity. This is true for most pitch accents in Malagasy, with the exception of most IP-final pitch accents. This IP-final stressed syllable is often not prominent and is marked with weak amplitude, regardless of the syntactic category of the IP-final word. In the present dataset, this IP-final word could be an adverbial, as in Figure 13, or part of the subject noun phrase, for example in Figure 14. As can be seen in Figure 14, the intensity of the IP-final pitch accented syllable, [mon], is very weak but shows a rising f0.

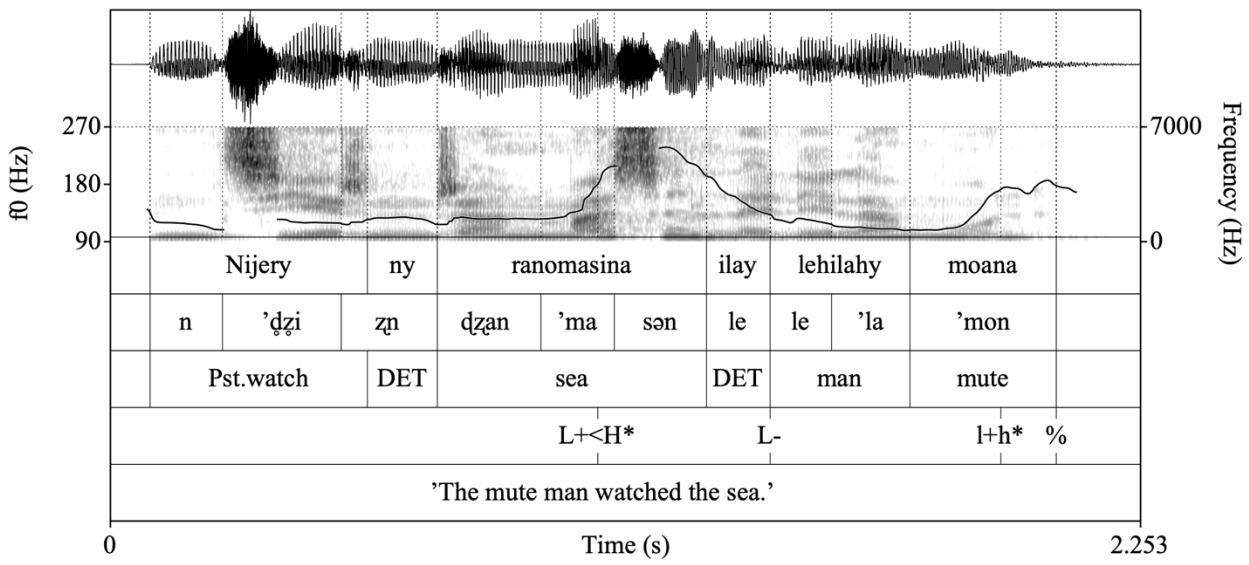

Figure 14: f0 track for *Nijery ny ranomasina ilay lehilahy moana* 'The lonely man watched the sea', shows that the stressed syllable of *moana* [mon] 'lonely' is weaker in intensity than preceding syllables but shows a rising pitch.

The non-prominent variant of L+<H* pitch accent is labeled as l+<h*, using lowercase letters in order to reflect the non-prominent status of the pitch accent; however, any of the L+<H* variants, described in the following subsections, may be realized without prominence (e.g., l+h*, l*+h, etc.). One could analyze this IP-final rising pitch as a boundary tone; however, I argue this not to be true. The first argument that l+<h* is not a boundary tone but a pitch accent comes from the occasional realization of prominence on the stressed syllable: in 43 utterances out of a sample of 135 (32%), the final stressed syllable of the utterance does bear prominence , indicating that in these cases, the tone is a proper pitch accent (an example is shown in Figure 15). The second argument is that there are cases where an IP-final low boundary tone (L%) is fully realized when there is a fully prominent pitch accent. If we assume that L% is the default boundary tone for all declaratives in Malagasy, the rise in pitch on the stressed syllable before

the boundary tone, even when lacking prominence, must not be a boundary tone, but rather a pitch accent.

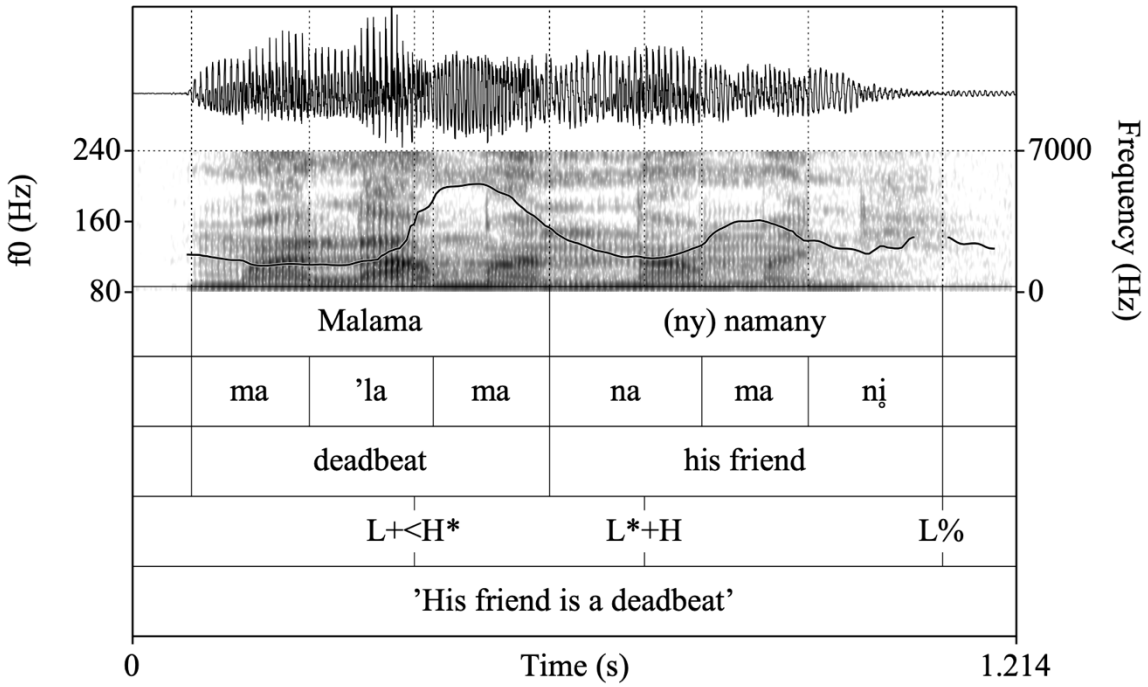

Figure 15: f0 track for *Malama ny namany* 'His friend is a deadbeat', where the IP-final pitch accent is prominent

Finally, the f0 shape and alignment of the f0 peak in l+<h* relative to the stressed syllable also resembles that of the proper pitch accents in Malagasy: like L+<H*, f0 starts low and rises throughout the stressed syllable, reaching its peak on the following syllable, though the f0 peak is typically much lower than the preceding pitch accent. Additionally, the alignment of the f0 peak with respect to the stressed syllable can be early in the same phonological context as the L+H* variant of L+<H* (therefore, when the peak of a rising tone appears on the stressed syllable but is not prominent, the tonal label l+h* was used; l+h* also frequently occurred when this pitch accent is on the final syllable of the IP). Further, the l*+h allotone appears when the

stressed syllable is early in the intermediate phrase, similar to the context in which the pitch accent L*+H appears (described in 5.1.2). For these reasons, I am considering l+<h* to be a pitch accent, and not a boundary tone.

5.1.4 uL*+H

Just as L+<H* is realized as L*+H when it appears two or three syllables to the right of the preceding pitch accented syllable, there are other instances where the close positioning of two tones results in variation of L+<H*. When two pitch accents are separated by a single syllable, the low target of the second pitch accent may be undershot, resulting in an f0 that is relatively higher than preceding low targets of the first pitch accent. This has been labelled uL*+H (or ul*+h when the host syllable is not prominent) and an example appears in Figure 16.

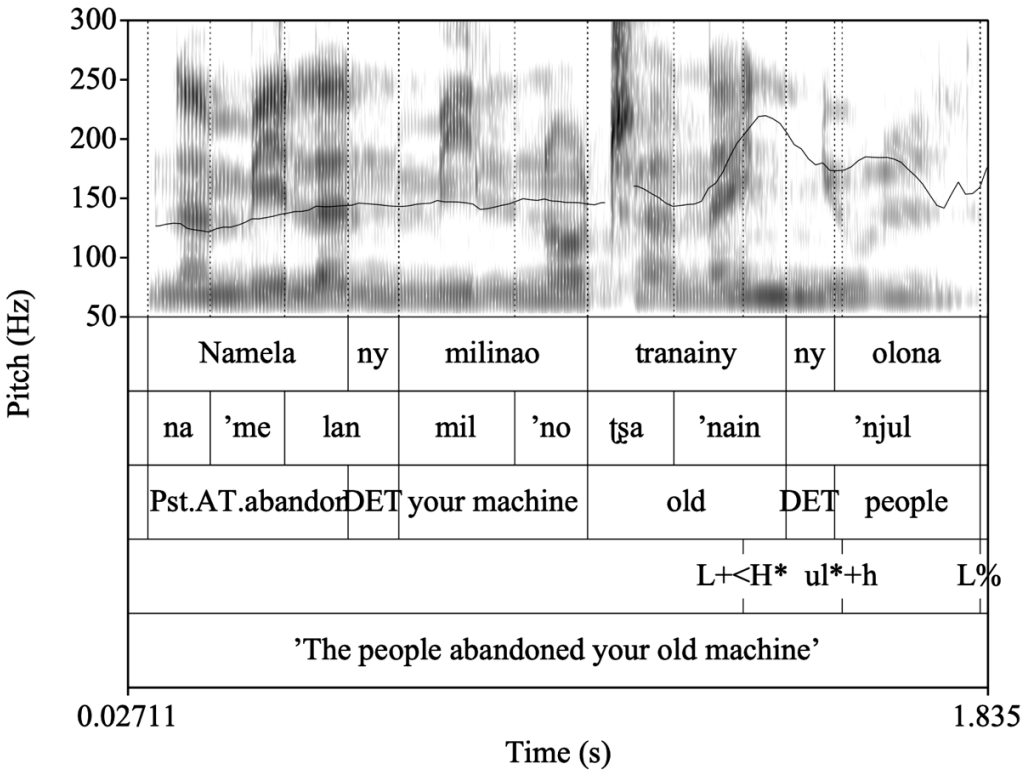

Figure 16: f0 track for *Namela ny milinao tranainy ny olona* 'The people abandoned your old machine'

5.2 L+<¡H*

The second distinctive category of pitch accent in Malagasy is L+<¡H*. This pitch accent type appears only in the IP-final position in questions, both yes/no and wh-. The default shape of L+<¡H* is similar to that of L+<H*, but unlike L+<H*, whose f0 peak is as high or lower than preceding H targets, the f0 peak of L+<¡H is relatively higher than preceding H targets; this upstepping of f0 is denoted by the upside-down exclamation mark (¡), adopting the usage in Spanish ToBI. The allotonic realizations of L+<¡H* are sensitive to the same phonological environments that trigger allotones of L+<H*; for example, when it closely follows the preceding pitch accent, it is realized as L*+¡H. Notably, since L+<¡H* appears in the IP-final position, it frequently lacks acoustic prominence, being realized as l+<¡h*; however, unlike the declarative sentences, it is never deleted in the present dataset, indicating that L+<¡H* plays an important role in marking an utterance as a question. Examples of L+<¡H* and a non-prominent variant appear in Figures 19 and 20, respectively.[9]

6. Prosodic Structure of Other Sentence Types

6.1 Complex Declaratives

6.1.1 Clausal Complements

As described in 2.2.1, when Malagasy verbs take clausal complements, the embedded clause, headed by the complementizer *fa*, is extraposed to the sentence-final position.
In terms of intonation, the embedded clause, which consists of a predicate and subject, behaves like a VOS simple declarative in terms of intonation, with the predicate and the subject each forming an intermediate phrase (ip) marked with intonation. Since the matrix predicate and subject each forms an ip, the total number of intermediate phrases, marked by a pitch accent, in a

[9] In Figure 19, the underlying L+<¡H* pitch accent is realized without a delayed peak as it appears on the final syllable of the IP.

typical sentence with a clausal complement is four. An example of a typical embedded clause is shown in Figure 17.

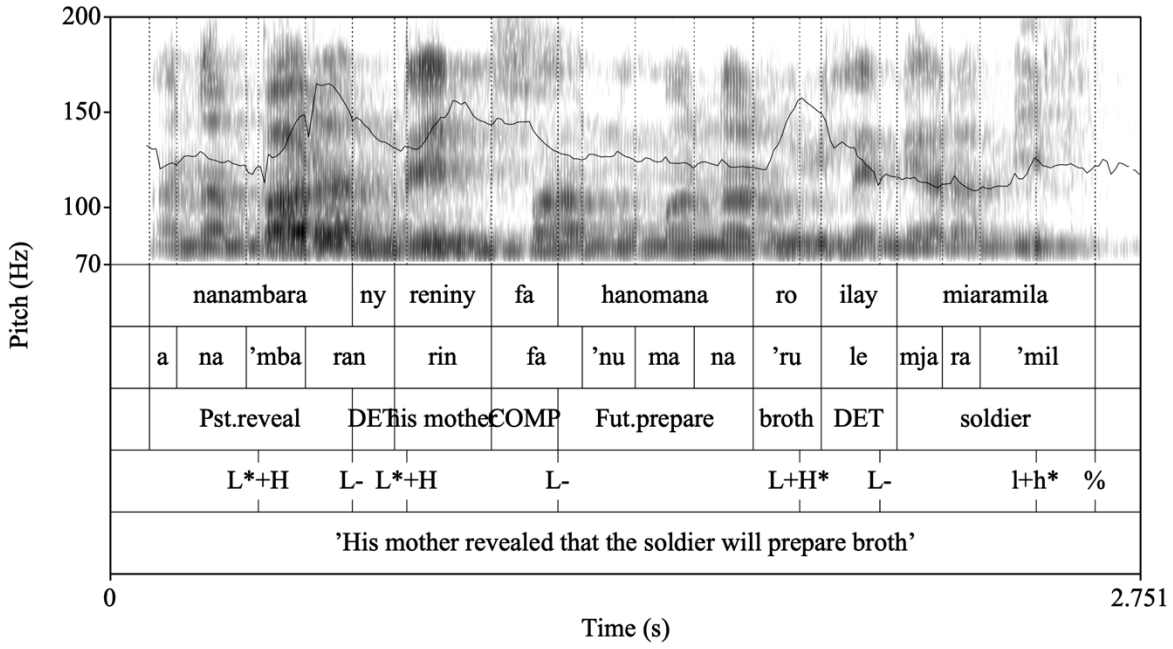

Figure 17: f0 track for *Nanambara ny reniny fa hanomana ro ilay miaramila* 'His mother revealed that the soldier will prepare a broth' showing the ip-final pitch accent on the predicate and subject of both the matrix and embedded clauses

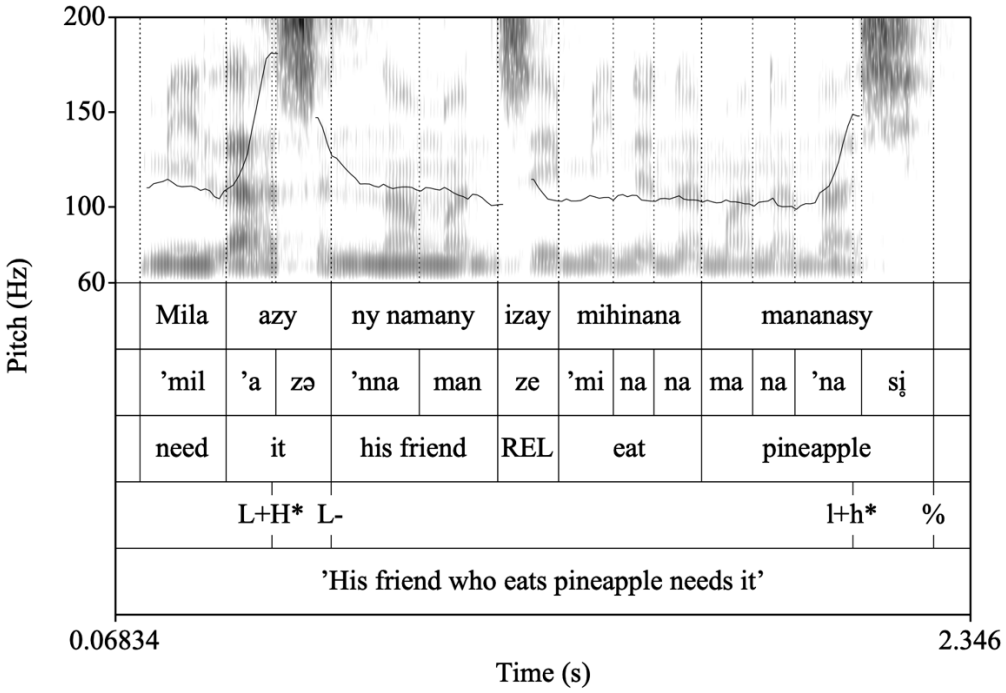

Figure 18: f0 track for *Mila azy ny namany izay mihinana mananasy* 'His friend who eats pineapple needs it' showing an embedded relative clause

6.1.2 Relative Clauses

Declaratives with embedded relative clauses modifying the subject show a different intonation pattern from that of the declaratives with a clausal complement. Even though there is a clause boundary between the subject noun and the relative clause, the subject noun does not receive any pitch accent. Instead, there is only one pitch accent realized at the end of the subject NP, which includes the relative clause that modifies the subject noun. This suggests that a pitch accent marks the end of a subject noun phrase, not a subject noun. Therefore, declarative sentences with relative clauses have a prosodic structure similar to simple declaratives, where the predicate and the subject NP each forms an intermediate phrase. As shown in Figure 18, *Mila azy ny namany izay mihinana mananasy* 'His friend who eats pineapple needs it', there are two pitch accents: one at the end of the predicate [$_{VP}$ mila azy] 'needs it and another at the end of the

subject NP, including its relative clause, [$_{NP}$ ny namany izay mihinana mananasy] ‘his friend who eats pineapple’.

6.2 Questions

Questions follow the same general prosodic structure as other sentence types in Malagasy, with each major syntactic constituent forming a prosodic constituent marked with intonation, in particular an intermediate phrase. However, while all declarative ips are marked with L+<H*, this is not true of all ips in questions; instead, the pitch accent on the *final* ip of the question is L+<¡H*, which is most commonly realized as the non-prominent l+<¡h*. This pitch accent looks like L+<H*.

6.2.1 Yes/No Questions

In addition to the prosodic constituents of the predicate, the subject NP, and an optional predicate-external adverb phrase that are marked with the L+<H* pitch accent in declarative sentences, the yes/no question particle *ve* is also marked with the L+<H* pitch accent. As described in 4.1.2, intermediate phrases in Malagasy are marked at their right edges with pitch accents; however, the data examined for the present study is not enough to determine whether or not the pitch accent on *ve* is demarcating an ip. Alternatively, it is possible that *ve* is marked with a pitch accent solely to denote prominence and does not form its own intermediate phrase. In order to evaluate whether the pitch accent on *ve* demarcates an ip, future research should examine yes/no questions with a greater phonological distance between *ve* and the following pitch accent in order to look for other markers of an ip boundary, such as a L- boundary tone. An example of a pitch-accented *ve* is shown in Figure 19.

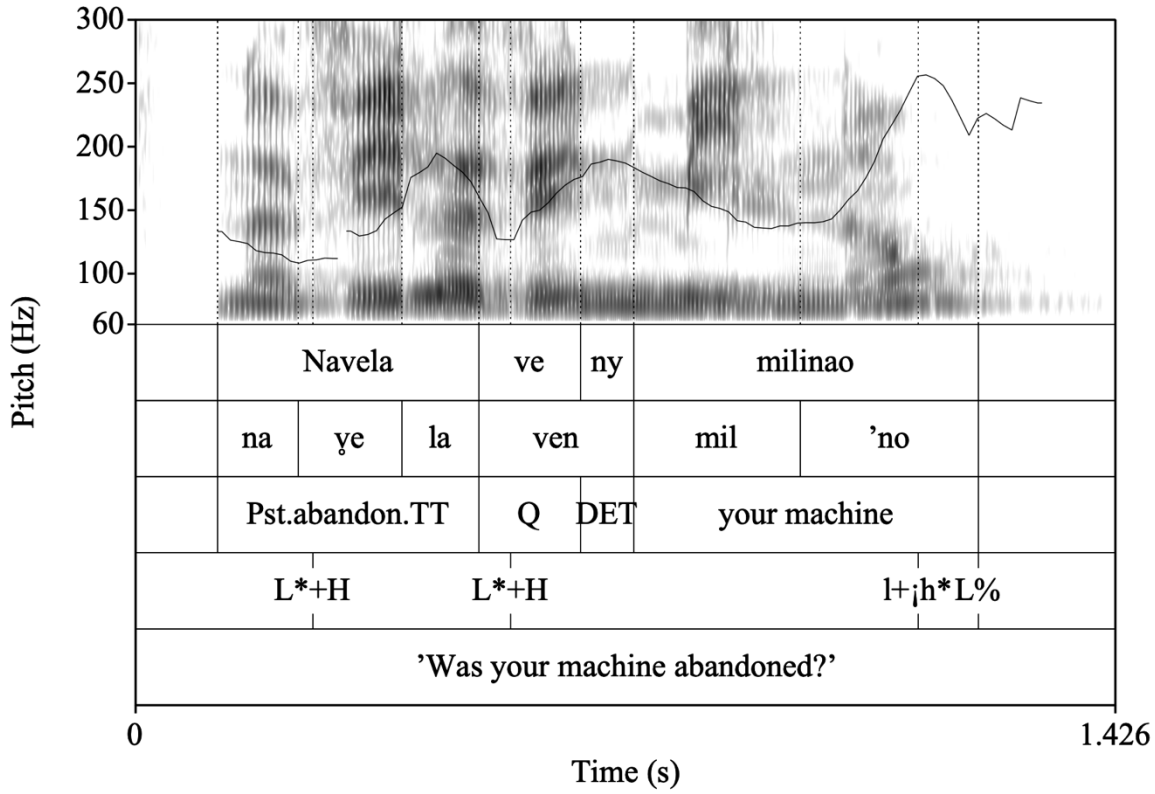

Figure 19: f0 track for *Navela ve ny milinao?* 'Was the machine abandoned?' showing the upstepped L+¡<H* (realized as the l+¡h* allotone) on the final word of a yes/no question

6.2.2 Wh-Questions

Wh-questions behave as expected given our knowledge of the syntactic and prosodic structures of Malagasy. For all wh-questions, the final pitch accent is L+<¡H*, as with yes/no questions. When wh-words appear in situ, the syntax is unaltered, and the predicate and the subject NP each forms an ip. However, in most cases where the wh-word appears in the sentence-initial position, the wh-word forms one ip, marked with a pitch accent, and the following clause, beginning with *no*, forms a second ip. As with pseudoclefts, this is expected if we adopt Paul's (2001a) and Potsdam's (2006) claim that the wh-word forms the predicate and the *no* clause forms the syntactic subject.

However, some wh-questions may have up to three intermediate phrases. Recall that wh-questions with an adverbial wh-word (e.g., *when* or *where*) may take a full VOS clause after the wh-word. In these sentences, the wh-question contains three ips, each marked with a pitch accent: the wh-word, the predicate following *no*, and the subject. A pitch track of a wh- question with *nahoana* 'why' appears in Figure 20.

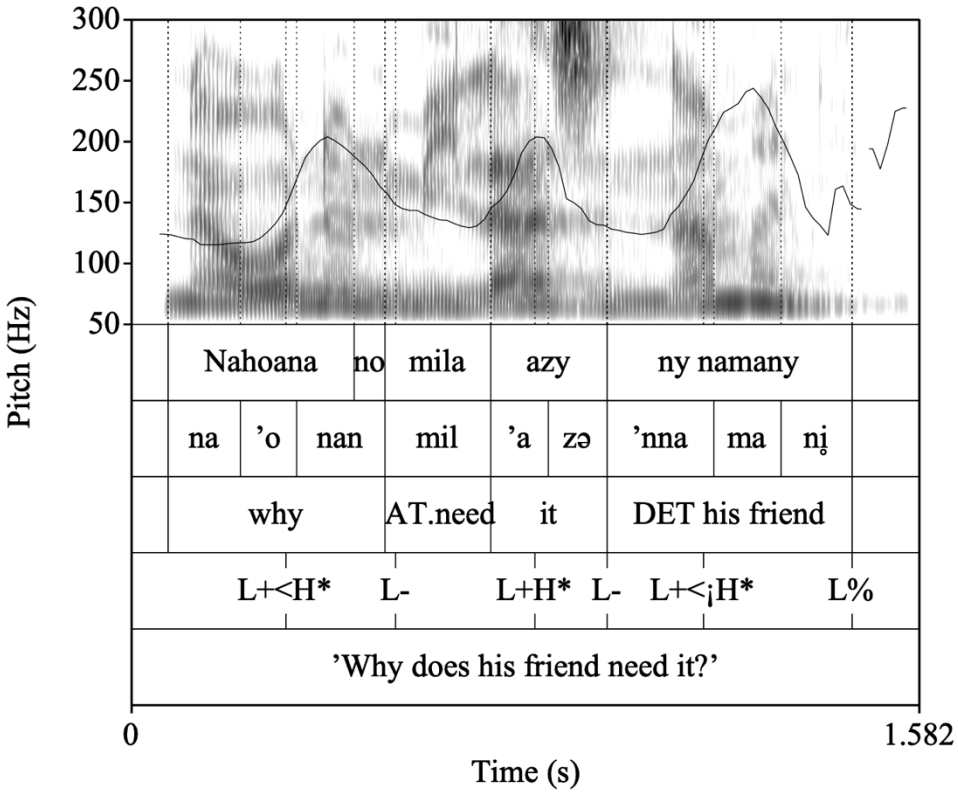

Figure 20: f0 track for *Nahoana no mila azy ny namany?* 'Why does his friend need it?' showing a wh- question that comprises three intermediate phrases

7. Discussion

There are several facts regarding the intonation of Malagasy that must be discussed further.

7.1 Which Syntactic Constituents Coincide with Prosodic Constituents?

In the limited body of literature that existed on Malagasy intonation prior to this study, there emerged two competing views of which syntactic constituents corresponded to prosodic constituents. Dahl (1952), Rafitoson (1980), and Barjam (2003) described that both the predicate and the subject form prosodic constituents, each marked with a pitch accent; in contrast, Raoniarisoa (1990) and Frascarelli (2010) described a pitch accent only on the predicate.

In my analysis, I found both arguments to have some truth to them. First, as I described in 4.1.2, both the predicate and the subject, along with predicate-external adverbials, are marked with a pitch accent, supporting Dahl (1952), Rafitoson (1980), and Barjam (2003); however, the final pitch accent of the sentence, which in most cases is the subject, frequently lacks prominence. This lack of prominence on the IP-final stressed syllable may explain why Raoniarisoa (1990) and Frascarelli (2010) did not consider it to be a pitch accent. My preliminary model settles this debate by showing that the IP-final rise in f0 is indeed a pitch accent, as evidenced by the tone's f0 shape, the alignment of the tone with the stressed syllable, and the distinction from the IP-final boundary tone. I introduced the lowercase notation (e.g., l+<h*) to distinguish the typical prominent pitch accent from this non-prominent pitch accent variant that appears on the surface form of the Malagasy utterance.

7.2 Pitch Accents Demarcate Prosodic Constituents

As described in my model of Malagasy intonational phonology, intermediate phrases are demarcated with a pitch accent on the rightmost stressed syllable. This is a typologically rare occurrence, and may have implications for intonation theory; in the Autosegmental-Metrical framework, the role of pitch accents is to mark prominence, and the demarcation of prosodic

constituents is typically reserved for boundary tones, so the fact that Malagasy uses pitch accents to mark prosodic boundaries is unusual.

This demarcative function of pitch accents is not completely unheard of, though. French has been argued to mark accentual phrase boundaries with pitch accents (Jun & Fougeron, 2000, 2002, Delais-Roussarie et al. 2015), while Niuean, an Austronesian language distantly related to Malagasy, also marks the right edge of the predicate and the subject with a pitch accent in VOS sentences (Clemens, 2019). With this growing number of languages known to use pitch accents in this way, it is clear that the assumptions made in the current theoretical frameworks need to be expanded in order to fully account for the intonation of the world's languages.

7.3 The Status of Ve

The model presented here also has implications for the syntax of Malagasy, in particular, with respect to the question particle *ve*. As previously described in 2.2.2, Paul (2001b) describes *ve* as a second-position clitic; however, according to my analysis, this cannot be true: *ve* is marked with a rising pitch accent. This means that *ve* cannot be a clitic, as it is not phonologically dependent on a host, as demonstrated by its ability to be stressed and bear a prominent pitch accent. Second, I described how it is difficult to determine whether the pitch accent on *ve* marks an intermediate phrase boundary, as other pitch accents do, or whether it simply marks prominence. In Malagasy, intermediate phrases correspond to syntactic phrases (predicate phrases, noun phrases, and adverbial phrases), so if *ve* forms an intermediate phrase, it would not be unreasonable to speculate that *ve* also forms a syntactic phrase of its own. This would contradict Paul's (2001b) claim that *ve* is a head. Future research should investigate the prosodic status of *ve* in order to inform our understanding of Malagasy syntax.

8. Conclusion

In this paper, I have outlined the details of Malagasy intonation of both declaratives and interrogatives and developed a model that accounts for the intonation contours of all these sentences. I propose that the highest prosodic unit in Malagasy is an intonational phrase, which is marked by low boundary tone at its right edge and also by the non-prominent pitch accent on the IP-final stressed syllable. I have also shown how intonational phrases are made up of multiple intermediate phrases that correspond to syntactic constituents and are marked at their right edge with a rising pitch accent and a low boundary tone.

This model contributes to our understanding of Malagasy in many ways, in particular what we know about Malagasy prosodic structure, the phonology and phonetics of intonational tones, and syntax. I showed how some prosodic constituents in Malagasy are marked with intonation and how the realization of Malagasy intonation can be affected by segmental and prosodic context. By showing the close relationship between Malagasy prosodic and syntactic constituents, I also showed how my model of Malagasy intonation can inform intonation theory and theories of syntax and help us to understand more about the syntactic structure of Malagasy.

However, there are several facts about Malagasy that are not yet uncovered and deserve attention in the development of a full model of Malagasy intonation. First, it should be determined whether Malagasy uses intonation to mark focus; I described the intonation of Malagasy *syntactic* focus, but prosodic focus should be included in a full model of Malagasy intonation. Second, given what we now know about the relationship between syntactic and prosodic structure, we should continue to investigate different syntactic constructions in Malagasy in order to confirm the model proposed in the paper. These constructions may include sentences with more complex syntactic structures, multiple wh- questions, and other sentence

types. Finally, in order to fully understand the way that Malagasy uses non-prominent pitch accent to mark intonational phrase boundaries, more data is needed from sentences that do not end with a subject or sentences that can trigger an IP break in the middle of a sentence.

To conclude, I have presented a preliminary model of Malagasy intonation, answering the three research questions:

(1) What is the prosodic structure of Malagasy and which prosodic constituents are marked by intonation?

(2) How do these prosodic constituents relate to syntactic structure?

(3) What is the inventory of tones that mark these constituents, and what are their allotones?

Future research should build upon this model to encompass all of the relevant facts about Malagasy prosody and intonation.

9. References

Albro, D. (2005). *A large-scale, LPM-OT analysis of Malagasy*. (Doctoral dissertation, UCLA).

Aziz, J. & Paul, I. (2019). The Intonation of Malagasy: A preliminary look. In S. Calhoun, P. Escuerdo, M. Tabain, & P. Warren (Eds.), *Proceedings of the 19th International Congress of the Phonetic Sciences, Melbourne, Australia 2019* (pp. 3792-3796). Canberra, Australia: Australasian Speech Science and Technology Association Inc. Retrieved from https://assta.org/proceedings/ICPhS2019/papers/ICPhS_3841.pdf.

Barjam, J. P. (2003). *The intonation of Malagasy declarative sentences*. Unpublished manuscript, UCLA.

Beckman, M., Diaz-Campos, M., McGory, J.T., & Morgan, T.A. (2002) Intonation across Spanish, in the Tones and Break Indices framework. *Probus* 14, 9-36.

Beckman, M. & Pierrehumbert, J. (1986). Intonational structure in Japanese and English.

Phonology Yearbook 3, 225-309.

Bishop, J. (2012). Information structural expectations in the perception of prosodic prominence . *Prosody and meaning*, *25*, 239.

Boersma, P., & Weenink, D. (2017). Praat: doing phonetics by computer (Version 6.0.24) [Software]. Available from http://www.fon.hum.uva.nl/praat/

Clemens, L. (2019). The use of prosody as a diagnostic for syntactic structure: The case of verb-initial order. University at Albany, State University of New York.

Cole, J., Mo, Y., & Hasegawa-Johnson, M. (2010). Signal-based and expectation-based factors in the perception of prosodic prominence. *Laboratory Phonology 1*(2), 425-452.

Dahl, O. C. (1952). Étude de phonologie et de phonétique malgache. *Norsk Tidsskrift for Sprogvidenskap 16*, 148-200.

Delais-Roussarie, E., Post, B., Avanzi, M., Buthke, C., Di Cristo, A., Feldhausen, I., Jun, S.-A., Martin, P., Meisenburg, T., Rialland, A., Sichel-Bazin, R., & Yoo, H.-Y., "Intonational Phonology of French: Developing a ToBI system for French" (2015) Sonia Frota and Pilar Prieto (eds.) *Intonation in Romance.* Oxford University Press.

Edmiston, D., & Potsdam, E. (2016). Linearization at PF: Evidence from Malagasy extraposition. Paper presented at the 47th Annual Meeting of North East Linguistic Society, Amherst, MA.

Erwin, S. (1996). Quantity and moras: An amicable separation. *The structure of Malagasy*, *1*, 2-31.

Frascarelli, M. (2010). Intonation, information structure and the derivation of inverse VO languages. In R. Mercado, E. Potsdam and L. Travis (eds.) *Austronesian and formal linguistics*. Amsterdam: John Benjamins. 81-101.

Gabriel, C., Feldhausen, I., Pešková, A., Colantoni, L., Lee, S., Arana, V., & Labstía, L. (2010). Argentinian Spanish intonation. In *Transcription of the Spanish Language*, 287-315. Retrieved from https://www.researchgate.net/publication/292249229_Argentinian_Spanish_intonation

Grice, M., Baumann, S., & Benzmuller, R. (2005) German intonation in Autosegmental-Metrical Phonology. In Jun, S.-A. (ed.), *Prosodic Typology: The Phonology of Intonation and Phrasing*. Oxford: Oxford University Press., 55-83.

Guilfoyle, E., Hung H., and Travis, L. (1992). Spec of IP and Spec of VP: Two subjects in Austronesian languages. *Natural Language and Linguistic Theory 10*, 375-414.

Gussenhoven, C. (2000). The boundary tones are coming: on the nonperipheral realization of boundary tones. *Papers in laboratory phonology V: Acquisition and the lexicon*, 132-151.

Hombert, J. M., Ohala, J. J., & Ewan, W. G. (1979). Phonetic explanations for the development of tones. *Language*, *51*(1), 37-58.

Howe, P. J. (2017). *Tonogenesis in Central dialects of Malagasy: Acoustic and perceptual evidence with implications for synchronic mechanisms of sound change* (Doctoral dissertation, Rice University).

Jun, S.-A. & Fougeron, C. (2000). A Phonological model of French intonation. In A. Botinis (ed.) *Intonation: Analysis, Modeling and Technology*. Kluwer Academic Publishers. 209-242.

Jun, S.-A. & Fougeron, C. (2002). Realizations of accentual phrase in French intonation. Probus, *14*(1), 147-172.

Keenan, E. (1976). Remarkable subjects in Malagasy. In C. Li (ed.) *Subject and topic*. New York: Academic Press. 249-301.

Ladd, D. R. (2008). *Intonational phonology*. Cambridge: Cambridge University Press.

O'Neill, T. (2015). *The phonology of Betsimisaraka Malagasy* (Doctoral dissertation, University of Delaware).

Paul, I. (2001a). Concealed pseudo-clefts. *Lingua*, *111*(10), 707-727.

Paul, I. (2001b). Ve as a second-position clitic. *Oceanic Linguistics*, *40*(1), 135-142.

Pearson, M. (2018). Predicate raising and perception verb complements in Malagasy. *Natural Language & Linguistic Theory*, *36*(3), 781-849.

Pierrehumbert, J. B. (1980). *The phonology and phonetics of English intonation*. (Doctoral dissertation, Massachusetts Institute of Technology).

Potsdam, E. (2006). More concealed pseudoclefts in Malagasy and the clausal typing hypothesis. *Lingua*, *116*(12), 2154-2182.

Prieto, P. & Roseano, P. (eds.) (2010) *Transcription of Intonation of the Spanish Language*. Lincom Studies in Phonetics 6 (Munich: Lincom Europa).

Rackowski, A., and Travis, L. (2000). V-initial languages: X or XP movement and adverbial placement. In A. Carnie and E. Guilfoyle (eds.) *The syntax of verb initial languages*. Oxford: Oxford University Press. 117-141.

Rafitoson, E. R. (1980). *Accent et intonation de la phrase objective en malgache-merina*. Provence: Université de Provence.

Rakotofiringa, H. (1982). Étude de phonétique expérimentale: L'accent et les unités phoniques élémentaires de base en malgache-merina (Doctoral dissertation, Atelier National de Reproduction des Thèses Université Lille III).

Raoniarisoa, N. (1990). *Accent and intonation in a Malagasy dialect*. (Doctoral dissertation, University College of North Wales).

Richardson, J.D., (1885). *New Malagasy English Dictionary*. Antananarivo: The London Missionary Society.