Chapter 4: Intonational Marking of Sentence Type

4.1. General Background

One of the major functions of Intonation is that of a marker of modality or sentence type. Languages often employ linguistic features to distinguish between different types of utterances like statements, polar questions, content questions, imperatives, and so on (Xu, 2002; Ladd, 2008). Apart from morpho-syntactic markers like particles and word-order, languages may also lend considerable functional load on intonation for marking different categories of sentences. This involves the relatively recurrent occurrence of a pitch pattern for a particular sentence type, which applies to utterances of varying lengths (Cruttendan, 1997). According to Pierrehumbert's 1986 model of intonational phonology, these pitch patterns include boundary tones and pitch accents (local f0 peaks and dips within the utterance). Every language thus has an inventory of different combinations of these two to mark different sentence types. While this applies to most intonation-only languages, pitch accents are not very prevalent in tonal languages. The lexical tones carried by words or syllables in tone languages are scarcely overridden by an intonation contour made of pitch accents. However, many tonal languages do make use of boundary tones on the right/left (or both) edges of utterances as intonational markers of sentence type (Yip, 2002; Ladd, 2008). In addition to that, tone languages may also resort to lowering or raising the pitch register, expanding or narrowing the pitch range, and final lengthening for marking modality. Given the frequently encountered intonational boundary tones in utterance edges across tone languages, Hyman and Monaca (2011) proposed three possible ways in which lexical tones interact with intonational tones at utterance boundaries: *accommodation*, *avoidance* and *submission* (see 1.2.3).

Variance in the realization of intonation in declaratives and question utterances, in particular, has been one of the more widely studied phenomena. Declaratives generally exhibit the f0 downtrend patterns in a language which include declination as well as downstep, if present. A large number of languages show the presence of an L% boundary tone at the end of declarative utterances. Such final lowering is considered to be an intonational feature in both tonal and intonation-only languages. It, however, is not universally found in all the languages. African tone languages Basaa (Makasso et al.,

2016) and Kɔnni (Cahill, 2016) are known for the absence of final lowering at utterance ends as the underlying lexical tones of the final syllables are maintained.

On the contrary, declaratives in Chickasaw (Gordon, 2005) and Greek negative declaratives (Arvaniti and Baltazani, 2005) have a final raising H%. Although rare, such instances verify the variability in ways intonation is manifested across languages. In many tone languages, suprasegmental features can also signal the end of a statement or declarative, for example, penult-lengthening in Chichewa and Tumbuka (Downing, 2017), which is also widely attested in Southern Bantu languages. Nateni, a Gur language (Neukom 1995), and Wobé, a Kru language (Marchese, 1983), use final lengthening as the singular marker of questions.

Hyman (2001) and Gussenhoven (2004) claim that languages with downsteps in declarative sentences may have suspended downsteps in interrogative sentences. Global or utterance final pitch raising has been one of the well-attested prosodic features of interrogatives (Lieberman, 1967; Bolinger, 1978; Ohala, 1984; Gussenhoven and Chen, 2000). Many tone languages also employ this strategy to encode polar questions, as seen in Thai (Luksaneeyanawin 1998), Akan (Kügler, 2017), and Yoruba (Fajobi, 2011). In Mandarin Chinese (Yuan, 2006), three types of pitch variations are employed for question sentences- overall f0 raising, f0 raising in the later part of utterances, and f0 raising in specific points of the pitch contour.

However, there are languages with intonation features that are opposite to this expected pitch raising. Rialland (2007, 2009) reported that many African languages exhibit a falling pitch contour in question utterance along with other phonological phenomena like final vowel lengthening, final low vowel (generally /a/), and a breathy termination, which together are called a 'lax question prosody.' Falling question contour or final lowering in question utterances are attested in several languages, including Kɔnni (Cahill, 2012), Dagaare (Nakuma, 1998), and Adioukrou (Marchese, 1983).

In many romance languages, different prosodic strategies for distinguishing commands have been reported. This involves the use of a particular nuclear pattern or other prosodic means like lengthening or pitch range variation (Frota and Prieto, 2015). In standard Chinese, the pitch contour of the imperative sentence undergoes global raising as well as compression of pitch range (Sun et al., 2008). In some tone languages, verbs in imperative constructions are identified through distinct grammatical tones. In Tswana

(Zerbian, 2017), low tone verbs receive a high tone on the initial syllable, which indicates its use as an imperative. In Akan, along with a grammatical tonal morpheme, an imperative utterance is intonationally marked by the absence of final tone neutralization-a, a feature seen in declaratives (Kügler, 2017).

List utterances are assumed to be realized with a characteristic pitch pattern. In German, non-final items of the list carry a progredient pitch, while the final elements show a falling pitch (von Essen, 1964). Fery (1993) reported the use of rising contours for non-final items in a list. Beckman and Pierrehumbert's (1986) analysis of lists in English revealed a descending f0 track with a downstep in each new item compared to the prior item. In Spoken Hebrew, the elements of a list each constitute a separate IU with LHL as pitch accent; this particular pitch pattern is referred to as "camel humps" intonation contour in the language (Matalon, 2017). Insertion of an intonational H* pitch accent on the first element of the list and lengthening of its final syllable is characteristic of list utterances in the Thetogovela dialect of Moro, a tone language of Sudan (Rose and Piccinini, 2017).

In this chapter, we primarily investigated the prosodic features exploited in Sylheti and Chokri to distinguish between different types of utterances. While Sylheti incorporates both superimposed phrasal tones and registers modification to encode the differences between neutral declaratives and questions prosodically, the role of pitch manipulation in Chokri is comparatively more limited.

4.2. Experimental Procedure

4.2.1. Participants and Stimuli

Scripted sentences were elicited from native speakers of Sylheti and Chokri for the production experiment conducted for this study. The same 10 participants (5 Chokri, 5 Sylheti) that took part in the production experiment for chapter 3 were the subjects for this study. The datasets for both languages consisted of multiple blocks, each containing different utterance types. The Sylheti corpus contained 20 Declaratives, 10 Polar Questions, 10 Wh questions, 4 Alternative Questions, 8 Imperative, 3 list utterances, 5 Complex Sentences, and 5 Compound Sentences. The Chokri corpus contained 25 Declaratives, 10 Polar Questions, 10 Wh questions, 4 Alternative Questions, 8 Imperatives, and 3 list utterances. The dataset was designed to incorporate tonal sequences that would occur in natural speech in the languages. Each speaker produced

five iterations of each sentence. A few tokens had to be discarded due to background noise. A total of 3225 tokens were used for the final analysis.

4.2.2. Procedures

The speech data was recorded using a portable recorder (Tascam DR 100) connected to a unidirectional head-worn microphone (Shure SM10A). The sentences were randomized before being shown to the participants on a laptop screen for production. The recordings were digitized at a sampling frequency of 44.1 kHz and 32-bit resolution. Post-recording, each sentence was segmented and converted into individual sound files for further processing and analysis. The segmentation of individual sentences was done manually, wherein syllable and word boundaries were marked and labelled after visual inspection and careful listening.

4.2.3. Quantification and Statistical Analysis

In order to perform quantitative analysis, values of relevant acoustic parameters such as f0, duration, or intensity were extracted using the Prosody Pro Praat Script (Xu, 2013). Measurement of both average and time normalized f0 at 10 points of each syllable was done to have information about pitch level and pitch movement on different points of the f0 contour. Mean duration and intensity were measured for each syllable. The extracted data was stored in .csv files for preprocessing and subsequent statistical analysis. To test the statistical significance of observed differences in terms of f0, duration, and intensity, a one-way repeated measure ANOVA was conducted using functions from the `statsmodels` library on Python. For visualization of quantitative analysis, graphs were produced using the `matplotlib` library in Python.

4.3. Results and Analysis: Intonation and sentence types in Sylheti

In this study, we attempted to examine how sentence types are intonationally marked in Sylheti. The data generated through the production experiment explores the intonational features employed by Sylheti speakers to distinguish between various sentence types. The results showed that Sylheti makes use of boundary tone type, pitch accent type, and overall changes in pitch register.

4.3.1 Declaratives and Yes/no Questions

Like most other South Asian languages, Sylheti generally follows SOV word order in all sentence types, while other orders are also possible. Polar or Yes/no questions maintain this order but also tend to include the sentence-final question particle /ni/ and/or the question word /kɨ̱a/ in the second position (as an enclitic to the sentence-initial word, cf. Bengali). In our experiment, the Q particle is included at the final position of the sentence, while the question word is included in the second position to ensure the most naturalness of the sentence. Consider the following sample examples examined in this experiment-

Examples:

1. zɔn	kɨ̱a	aiz	ʃɔkal-é	ɸɔ́r-aɨ̱	as-l-ɔ́	ni
John	Q	today	morning-ADV	study-INF	exist-PST-3	Q

'Was John studying this morning?'

2. mamáe	kɨ̱a	gɔ́r	e-xán	bana-is-ɔ́in	ni
uncle-ERG	Q	house	one-CLF	build-PRF-HON	Q

'Has (my maternal) uncle built a house?'

Both types of sentences constitute IPs and have (L)HL% on their right edges. However, the question word /kɨ̱a/ carries the highest peak on the entire pitch contour, projected in the form of an H* pitch accent. The H tone associated with the question word can be distinguished from Ha due to the scaling of its peak, which is higher than all the AP boundary tones. This suggests a heavier semantic weight on the question word, also reported in other languages like English (Grabe et al., 2005), Dutch (Haan, 2001), and Tamil (Keane, 2006).

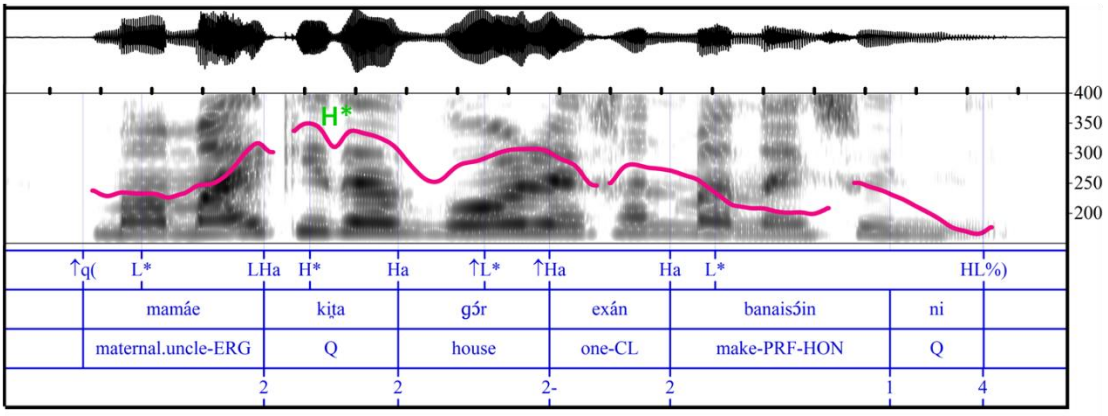

Figure 4.1: f0 contour of the sentence [mamáe kita gɔ́r exán banaisɔ́in ni], 'Has (my maternal) uncle built a house?' produced by a female speaker

In **Figure 4.1 and 4.2,** the question word /kiṯa/ in yes/no questions is realized with a f0 peak, a H* PA. The underlying LL lexical tones of the word are not retained when the word appears in a yes/no question. Moreover, the H tone of this PA is scaled higher than the rest of the H tones in the same sentence. It is not affected by the process of downstepping. Downstepping resumes after the question word as subsequent H tones get realized with gradually lowering f0s. Due to the influence of the intonational f0 peak, sometimes the previous AP boundary tone may be realized with a sharp rise, producing an LHa boundary tone **(Figure 4.1.)**

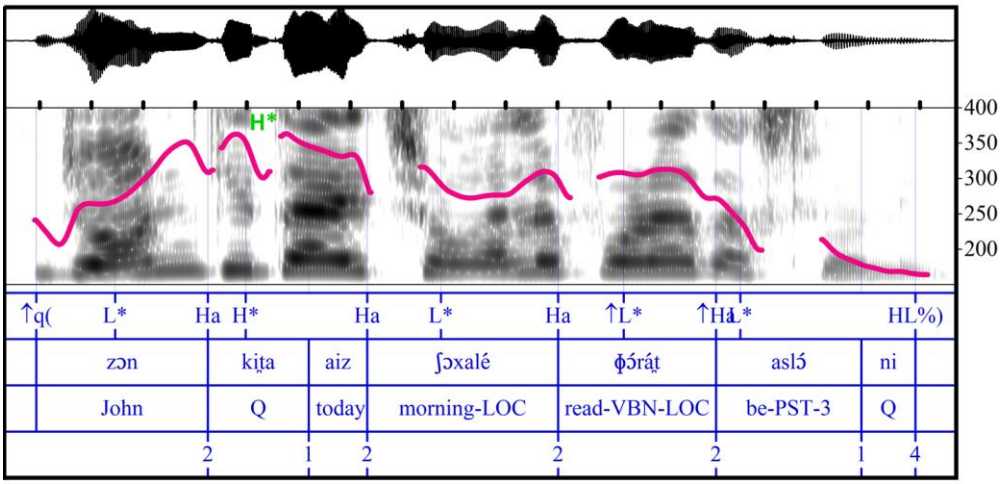

Figure 4.2: f0 contours of the sentences [zɔn kiṯa aiz ʃɔkalé ɸɔ́raṯ aslɔ́ ni], 'Was John studying this morning?', produced by a female speaker

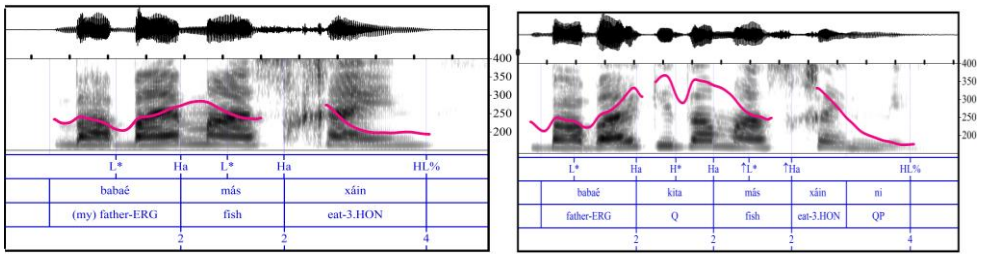

Fig 4.3: f0 contours of yes/no question [babaé más xáin ni] 'does (my) father eat fish?' (right panel), and its declarative counterpart [babaé más xáin ni],'(my) Father eats fish,'(left panel) of all tokens produced by five native speakers.

In yes/no questions that do not contain the question word /kita/, the pitch track resembles their declaratives counterparts, see **Figure 4.4**.

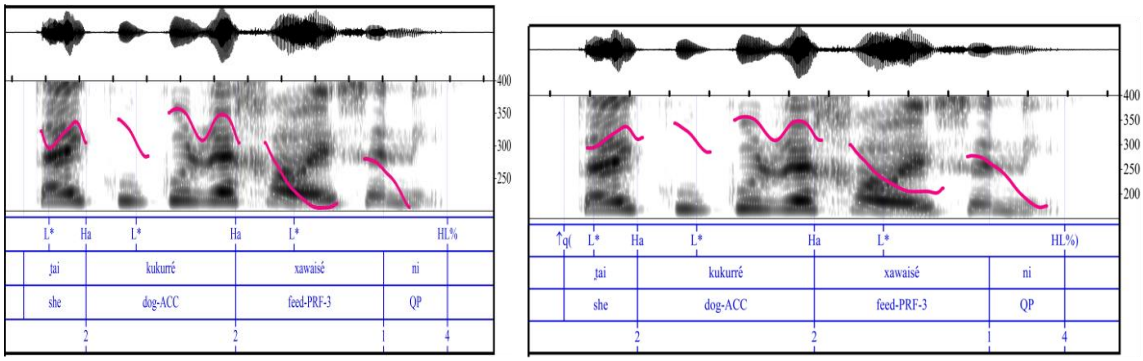

Fig 4.4: f0 contours of the yes/no question [ʈai kukurré xawaisé ni] 'has she fed the dog?' (left panel). Its declarative counterpart [ʈai kukurré xawaisé] 'she has fed the dog' is in the right panel. Both sentences are produced by a female speaker.

Another prosodic feature that distinguishes between these two types of sentences is pitch register raising. In polar questions, the pitch contours are realized with higher f0 scaling in comparison to their declarative counterparts. This becomes evident when f0 values of all syllables of both types of types of sentences are plotted for comparison (**Figure 4.5-4.7).**

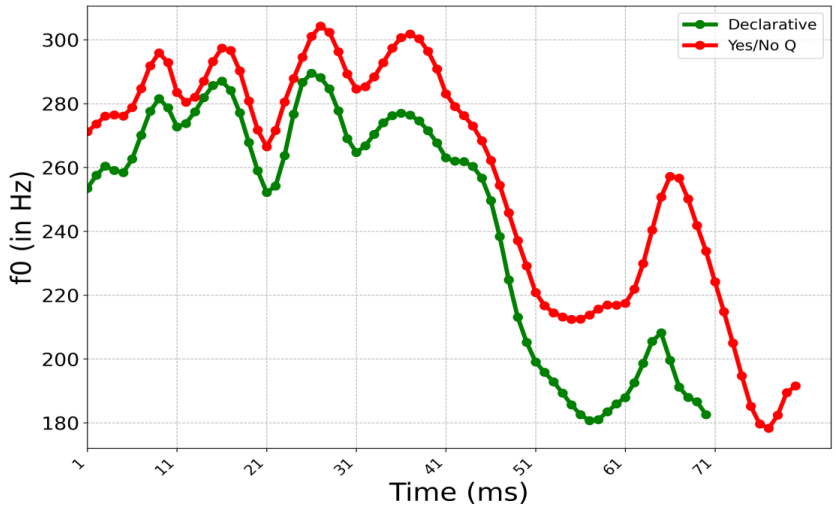

Figure 4.5: time normalized mean f0 values of each syllable of the yes/no question [ʈai kukurré xawaisé ni] 'has she fed the dog?' (in red) and its declarative counterpart [ʈai kukurré xawaisé] *'she fed the dog'* (in green) of all token produced by five native speakers.

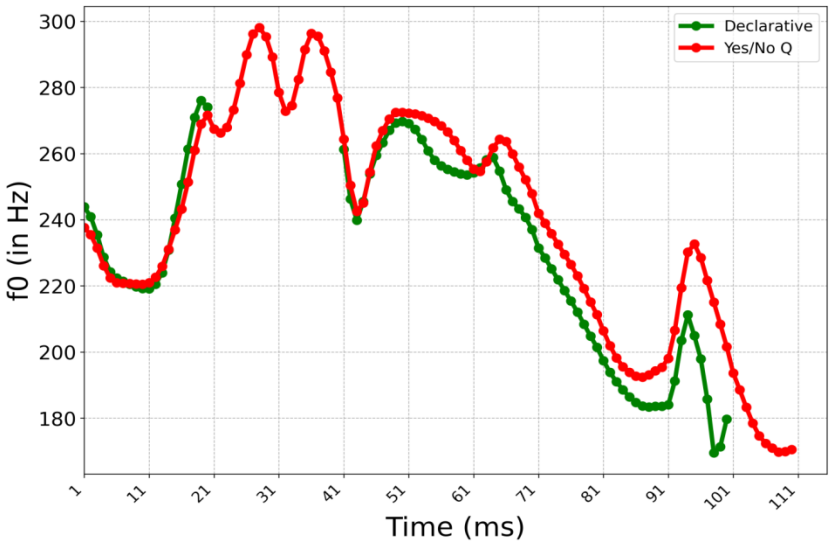

Figure 4.6: time normalized mean f0 values of each syllable of the yes/no question [mamáe kiṯa gɔ́r exán banaisɔ́in ni] 'has (my maternal) Uncle built a house?' (in red), and its declarative counterpart [mamáe gɔ́r exán banaisɔ́in], '(my maternal) Uncle has built a house', (in green) of all tokens produced by five native speakers.

As seen in **Figure 4.5 and 4.6**, the f0 of the syllables in the yes/no questions is realized with higher scaling. This confirms that the global register is rising as one of the significant markers of yes/no questions in Sylheti.

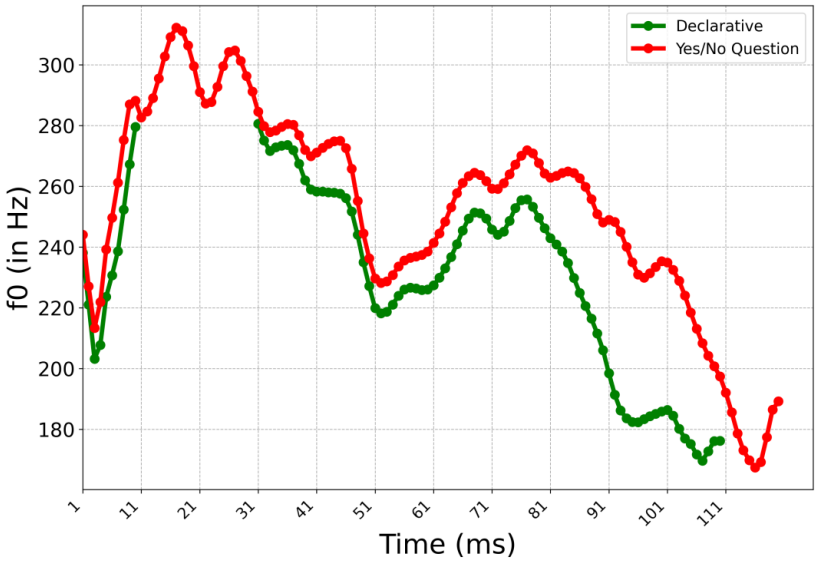

Figure 4.7: time normalized mean f0 values of each syllable of the yes/no question [babaé más xáin ni] '(does (my) father eat fish?' (in red), and its declarative counterpart [babaé más xáin], '(my) Father eats fish', (in green) of all tokens produced by five native speakers.

We also compared the duration values of the syllables in polar questions and their corresponding declaratives. Polar questions in Sylheti involve a reduction in the duration

of constituent syllables. However, this reduction is more likely due to the need to accommodate more syllables in the polar question utterances.

To determine whether the observed differences of f0 and duration between declaratives and polar questions are statistically significant, a one-way repeated measure ANOVA was performed using the built-in AnovaRMfunction from the statsmodels.stats.anovais in Python. The one-way repeated measure ANOVA was carried out by converting the 'speaker' as the categorical variable and the 'sentence type' as a string. The syntax *AnovaRM(data=data, depvar='dependent variable', subject='speaker', within=['type'], aggregate_func='mean').fit()* is used, where the dependent variable is f0, intensity, and duration. The $p < 0.05$ is considered as statistically significant.

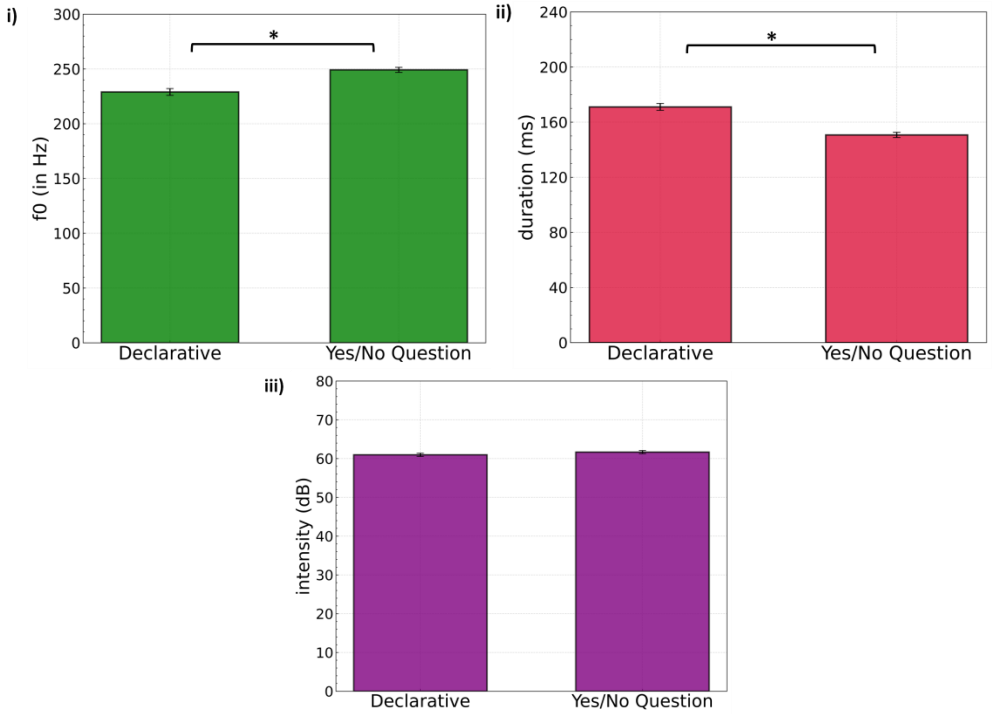

Figure 4.8: draws the results of the repeated measure one-way ANOVA showcasing a comparison between the declarative sentence and the polar question in terms of f0, intensity, and duration. An (*) indicates the significant pairs; (I) shows the trend for the frequency (f0 in Hz), (II) intensity (in dB), and (iii) duration (in ms).

The one-way repeated measure ANOVA show that f0 and duration variables are statistically significant between the declarative sentence and the polar question. In contrast, these two sentence types showcased no significant interaction in terms of intensity values. **Figure 4.8**(I-III) exhibits that the f0 of the polar question is approximately 20 Hz higher than that of the declarative sentences and is observed to be

significant ([F(1, 4) = 8.6, p = 0.042]). In contrast, the intensity of the declarative and the polar question sentences is 60 dB, showcasing a non-significant interaction ([F(1, 4) = 2.2, p = 0.215]). Furthermore, the duration of the Yes/no question sentence is ~30 ms more than that of the declaratives and is observed to be statistically significant ([F(1, 4) = 144.06, p = 0.0003]).

4.3.2. Wh Questions

Wh questions in Sylheti are normally constructed using wh-interrogative words left in situ. Consider the foloowing sample example sentences considered in this study-

3. t̪umi zɔn-ré t̪ar bɔi kun ʃɔmɔi d̪i-t̪-áe
you John-ACC his book which time give-FUT-2
'When will you give John his book?'

4. t̪umi xanɔ aʃ-l-ae
you when come-PST-2
'When did you come?'

However, the question word may also occur word finally.

5. t̪umi inɔ́ ubat̪ xene
you here stand why
'Why are you standing here?'

Prosodically, wh-questions are realized using strategies similar to yes/no questions. The most distinctive marker of wh questions in Sylheti is the H* pitch accent on the question words. This PA is often realized with a higher f0 than other H tones in the sentence, indicating a relatively greater salience. In **Figure 4.9**, on the question word /kun/ 'which,' the pitch is of the highest value (301 Hz) in the entire utterance. A similar instance is shown in **Figure 4.10**, where the H* PA on the question word /kit̪a/ has a pitch value of 369 Hz. The Non-final question words block the effect of downstepping. The question sentences where the wh question word occurs at the right boundary appear to be an exception since they are overridden by the IP final boundary tone. **Figure 4.12** demonstrates the case of question words that occur at the right boundary. The word /xene/ 'why' does not undergo raising and is subject to final lowering. Like yes/no questions, wh questions also have a higher global pitch compared to declaratives.

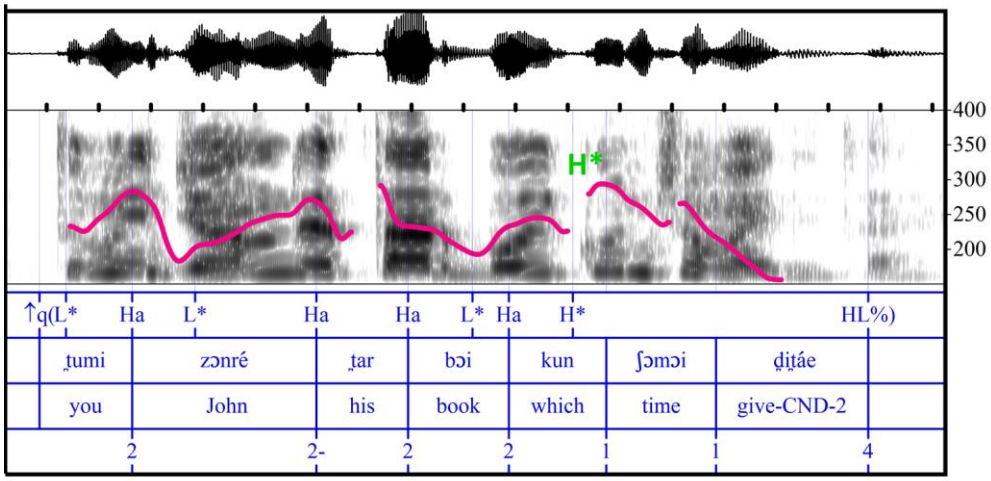

Figure 4.9: f0 contour of the sentence [ʈumi ʒɔnré ʈar bɔi kun ʃɔmɔi ɖiʈáe?], 'When will you give John his book?', produced by a female speaker

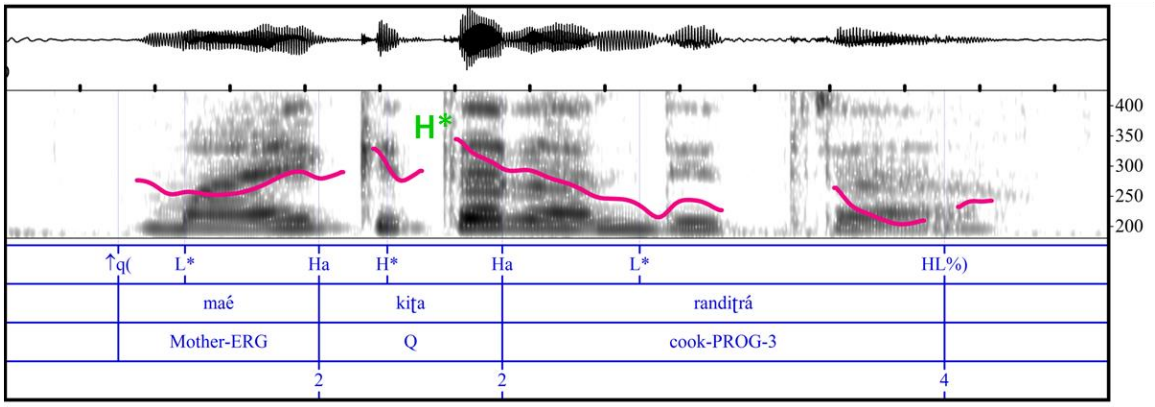

Figure 4.10: f0 contour of the sentence [maé kiʈa randiʈrá?], *'what is (your) mother cooking?'*, produced by a female speaker.

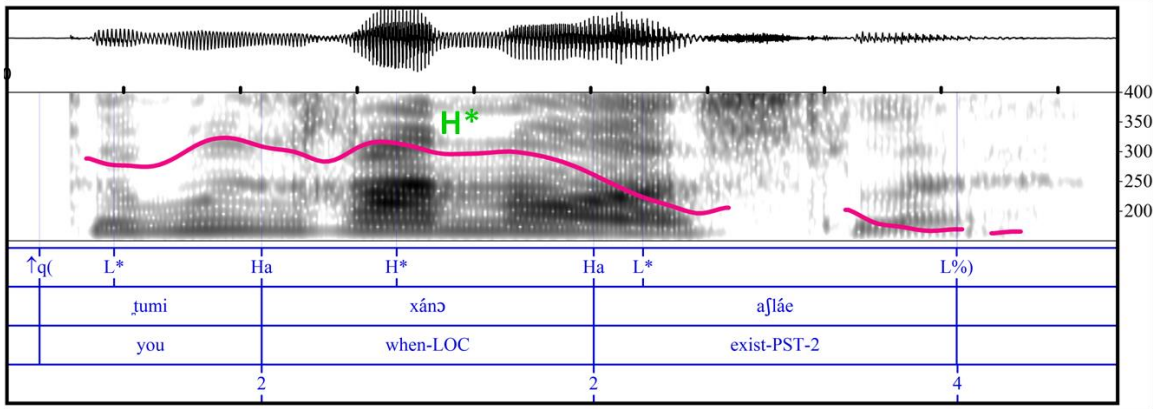

Figure 4.11: f0 contour of the sentence [ʈumi xanɔ aʃláe?], 'where have you been?', produced by a female speaker

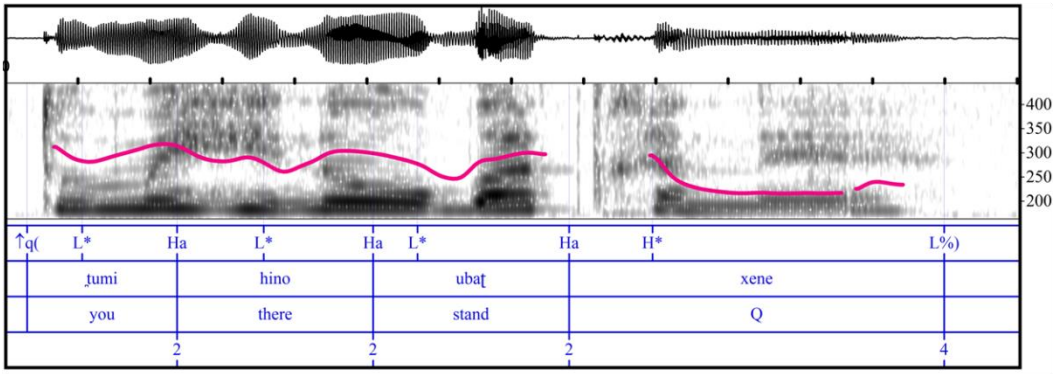

Figure 4.12: f0 contour of the *sentence [*ʈumi hino ubaʈ xene*?] 'why are you standing there?',* produced by a female speaker.

Visual observation of pitch tracks and extraction of the average f0 of each wh-question sentence presented the impression that wh-questions, just like polar questions, undergo pitch register raising. A one-way repeated measure ANOVA test was then performed to investigate whether the differences in the f0 scaling are statistically significant.

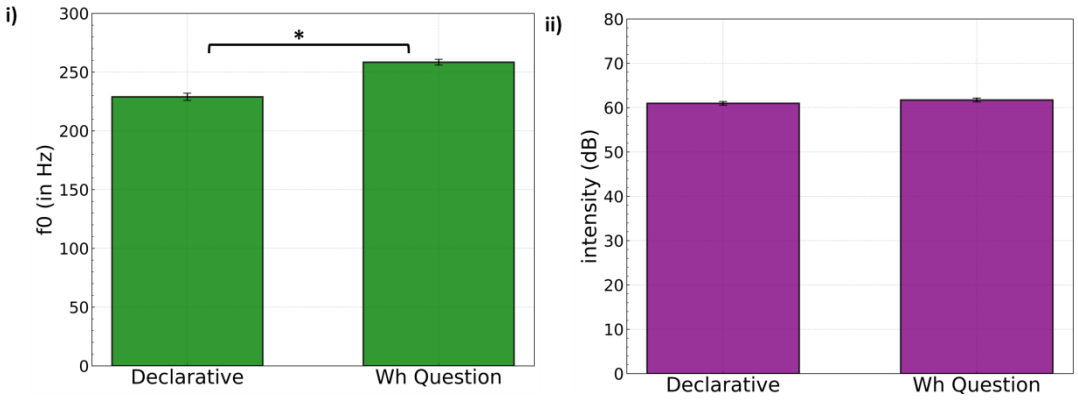

Figure 4.13: draws the results of the repeated measure one-way ANOVA showcasing a comparison between the declarative sentence and the wh question in terms of f0 and intensity. An (*) indicates the significant pairs; (I) shows the trend for the frequency (f0 in Hz) and (II) intensity (in dB).

Like the declarative and polar question scenario, the repeated one-way ANOVA measures show that the variable f0 is significant between the sentence and the wh question. In contrast, there is no significant difference in the intensity. **Figure 4.13**(I-II) exhibits that the f0 of the wh-question is approximately 25 Hz higher than that of the declarative sentences (f0 [$F(1, 4) = 23.22$, $p = 0.008$]). In contrast, the intensity values in the declarative and the wh-question are around 60 dB and are observed to be non-significant ([$F(1, 4) = 3.69$, $p = 0.127$]).

4.3.3. Alternative Questions

Alternative questions in Sylheti present two alternative object/subject NP or VP elements from which the addressee chooses one as the answer. These alternatives are separated by adding a question particle '*na*' between them. Alternative questions that offer an alternative choice between two objects do not make use of any distinct phrasal tones. Questions with two alternate VPs, however, can be identified through prosodic phrasing wherein the first element constitutes a singular ip, marked by an L-boundary tone **(Figure 4.15)**. In Sylheti, alternative questions undergo pitch register raising, too. This confirms register expansion as a marker of all question sentences in the language.

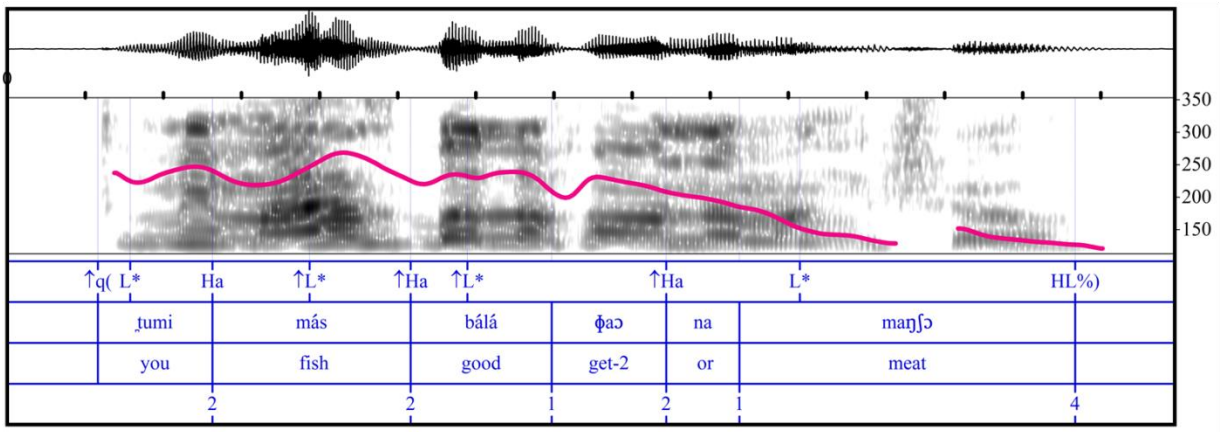

Figure 4.14: f0 contour of the sentence [ʈùmì mas bálá ɸàɔ nà màŋʃɔ̀] *'do you like fish or meat?'* produced by a male speaker

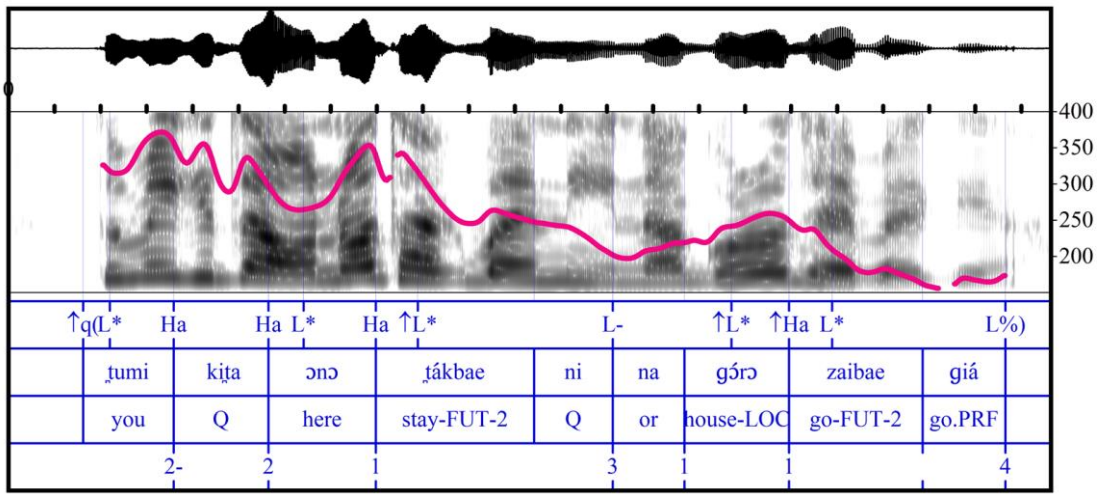

Figure 4.15: f0 contour of the sentence [ʈumi kiʈa ɔnɔ ʈakbáe ni na gɔ́rɔ zaibaegía] '*will you stay here or go home?'* Produced by a female speaker

Pitch register raising in alternative questions has been confirmed through results obtained from the repeated measure ANOVA tests.

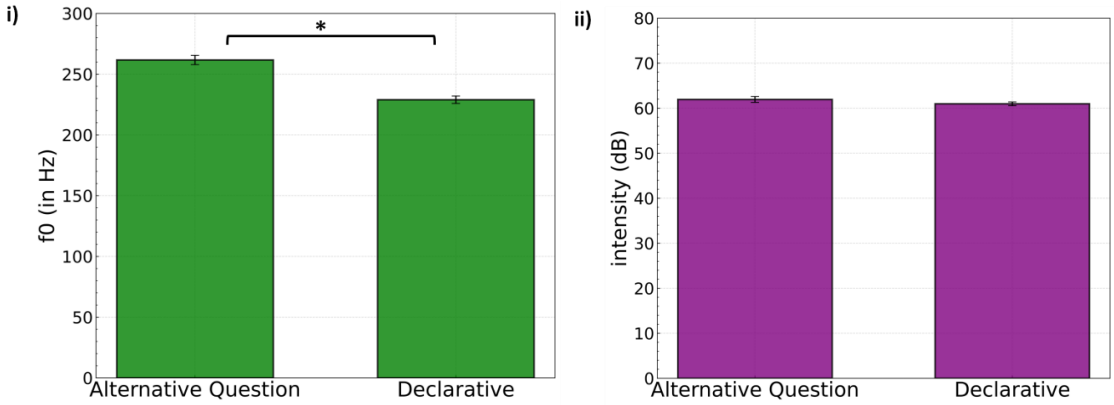

Figure 4.16: draws the results of the repeated measure one-way ANOVA showcasing a comparison between the declarative sentence and the alternative question in terms of f0 and intensity. An (*) indicates the significant pairs; (I) shows the trend for the frequency (f0 in Hz) and (II) intensity (in dB)

Figure 4.16 exhibits that the f0 of the alternative questions is approximately 30 Hz higher than that of the declarative sentences that are observed to be significant ([F(1, 4) = 11.66, p = 0.026]). The intensity of declarative sentences and alternative questions differs by ~2 dB and is observed to carry a significant difference ([F(1, 4) = 13.82, p = 0.021]).

4.3.4. **Imperatives**

In terms of intonational properties, imperative utterances in Sylheti do not differ much from declaratives. These kinds of sentences follow the prosodic organization of APs and IPs, similar to those observed in statements. We did not observe any distinction of pitch register or boundary tones that would prosodically mark imperative constructions as distinct from corresponding declaratives (**Figure 4.17)**.

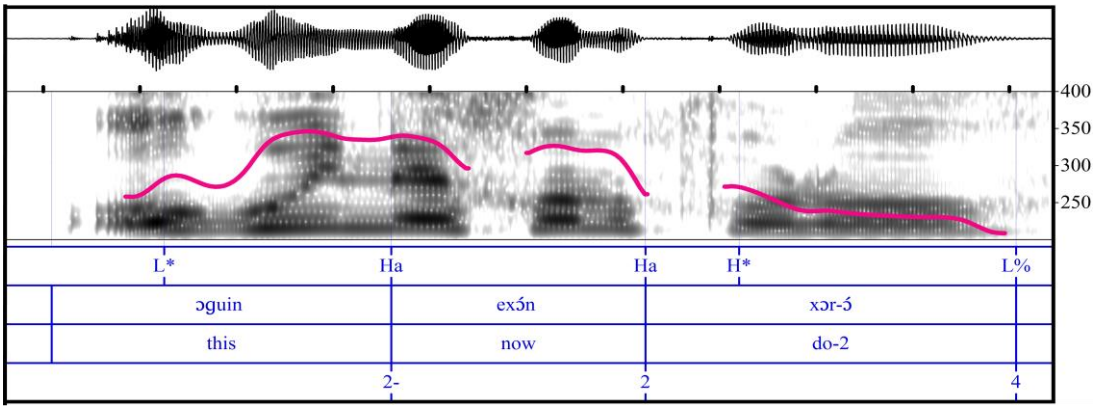

Figure 4.17: f0 contour of the sentence [ɔguin exɔ́n xɔrɔ́] '*do it now*' produced by a female speaker

4.3.5. Lists

In Sylheti, utterances containing a list of elements are often constituted with the coordinating conjunct /ar/ ‘and’ before the final element. For example:

6. ami mama məi bái ar bɔin-ór ləgé mil-ʃ-í
   I uncle aunt brother and sister-GEN with meet-PST-1
‘I met with (my maternal) uncle, (my maternal) aunt, (my) brother, and (my) sister.’

List utterances are mostly identifiable through prosodic means. Intonationally, non-final elements in Sylheti constitute individual prosodic units. Perceived junctures and a sharp rise in pitch at right boundaries mark these units. Both these properties make it prosodically different from the APs we have observed so far in the language. Rather, this unit can be equated with a higher prosodic constituent, i.e., the ip. In **Figure 4.18**, all non-final elements [mama], [məi], [bái] each constitute singular ips. Similarly, the ips in **Figure 4.19** are [ɸɔ́l], [ʃɔbʒi], [d̪úd̪], and [maŋʃɔ]. The later portions of the utterance are similar to non-list utterances.

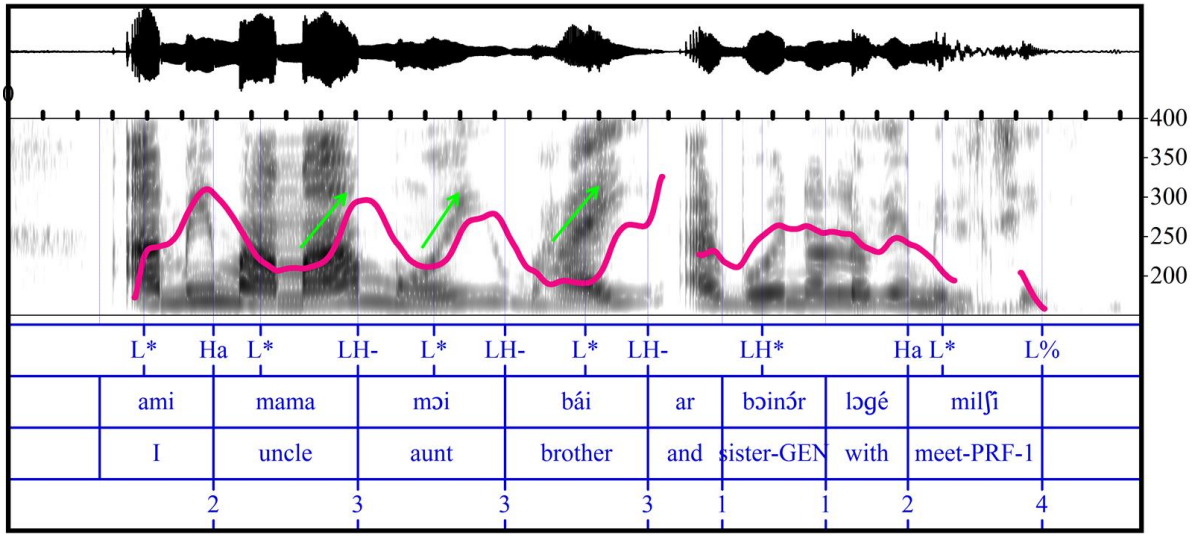

Figure 4.18: f0 contour of the sentence [ami mama,məi,bái, ar bɔinɔ́r ləgé milʃĭ], ‘*I met with my uncle, aunt, brother, and sister’*, produced by a female speaker

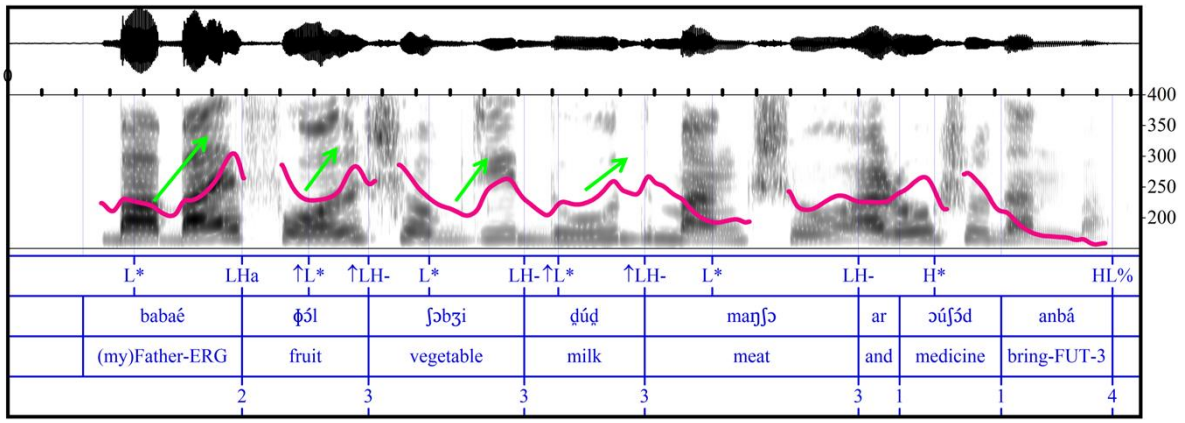

Figure 4.19: f0 contour of the list utterance [babaé ɸól, ʃɔbʒi, ɖúɖ, maŋʃɔ ar ɔúʃɔd anbá] '*(my) father will bring fruits, vegetables, milk, meat and medicine'* produced by a female speaker

4.3.6. Compound Sentences

Compound sentences can be made up of two IPs. The first IP is the first clause before the coordinating conjunct. It is marked with H% at the right boundary, followed by a pause. The second IP corresponds with the second clause. It goes through a pitch reset at its beginning and ends in an L% for declaratives.

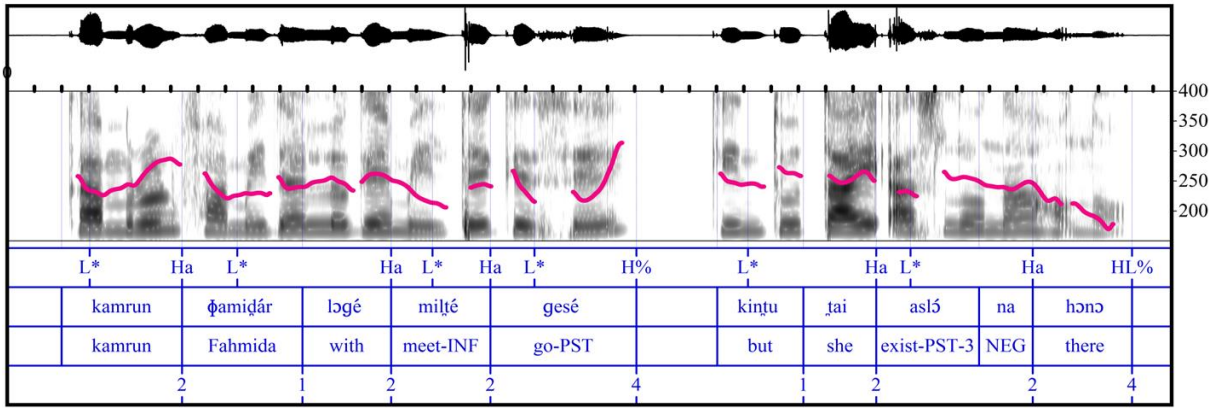

Figure 4.20: represents the pitch contour of the compound sentence [kamrun ɸamidár lɔgé miɭté gesé kinʈu ʈai aslɔ na hɔnɔ] '*Kamrun went to meet Fahmida, but she was not there'*, produced by a female speaker

Figure 4.20 shows the pitch reset at the beginning of the subordinate clause. The matrix clause can be seen to end with an L-tone. Apart from pitch, the two clauses are separated with a longer pause than pauses between words. This is annotated in the diagram with break index number three on the fourth tier. The HL% boundary tone of IP the can be seen on the right edge of the utterance.

4.3.7. Complex Sentences

Just like compounds, complex sentences in Sylheti are IPs made up of constituent intermediate phrases. However, the matrix clause, i.e., first ip has an L- tone at its right boundary. It is followed by a pause or juncture. The subordinate clause undergoes pitch reset which marks the beginning of the second intermediate phrase.

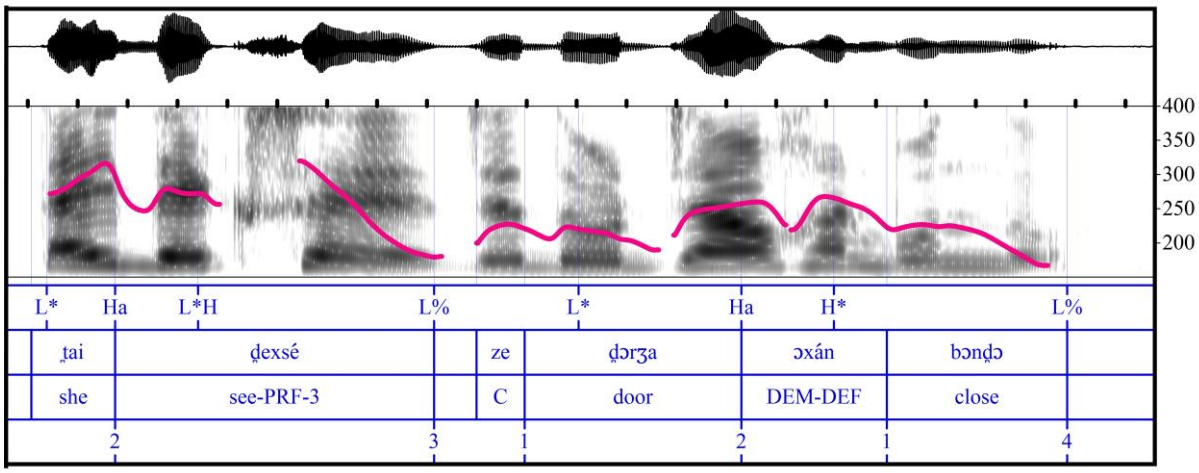

Figure 4.21: f0 contour of the sentence [ʈai ɖexsé ze ɖɔrʒa ɔxán bɔ́nɖɔ́] '*she saw that the door was closed*' produced by a female speaker

Figure 4.21 shows the pitch reset at the left boundary of the second ip, the subordinate clause. The pause between the two is marked with break index 3 in the fourth tier. In the instance of IP final lowering, a recurring pattern is observed in Sylheti. In compound sentences, the matrix clause ends with a rising L-boundary, distinguishing it from complex sentences.

4.4. Intonation and Sentence Types in Chokri: Results

4.4.1. Declaratives and Yes/No Questions

Neutral declarative sentences in Chokri follow SOV word order. Like many other tonal languages, Chokri has a repertoire of sentence-final particles that are exclusively reserved for indication of sentence types. All yes/no questions in Chokri obligatorily have the sentence-final question particle /mɛ̄/. Thus, structurally, they differ from their declarative counterparts due to the presence of sentence-final question marking elements.

Two illustrations of declarative-yes/no question pair are given below:
E.g.:

7.a) ā-pɔ̄ fə̋ tì- jɔ̄
1P.GEN-Father fish eat-HAB
'My father eats fish.'

b) m̄-pɔ̄ fə̋ tì- jɔ̄ mɛ̄
2.GEN-Father fish eat-HAB QP
' Does your father eat fish?'

8.a) í ātɔ̀ zə̋ kɔ̄zɛ́
I Ato with fight
'I fought with Ato.'

b) nɔ̄ ātɔ̀ zə̋ kɔ̄zɛ́ mɛ̄
you Ato with fight QP
'Did you fight with Ato?'

In terms of prosody, the surface pitch contours of both declaratives and question utterances in Chokri are made up of the underlying lexical tones of the syllables. None of the edges (left and right) of the utterance contain any superimposed intonational boundary tone for marking sentence type. Moreover, the IP final lengthening is present in all utterances regardless of the sentence type. Both types of sentences undergo a phonetic downtrend effect as well.

Figure 4.22 to **Figure 4.24** shows the f0 realization of three pairs of declarative and polar question utterances. The retention of lexical tones in each syllable can be confirmed through the distinctly visible differences in the scaling of the pitch contour in each syllable. At both edges, the pitch tracks are level and are realized within the tonal space of the lexically specified tone of initial and final syllables. This confirms that no phrasal tone participates in making up the surface f0 contour of neutral declaratives and yes/no questions.

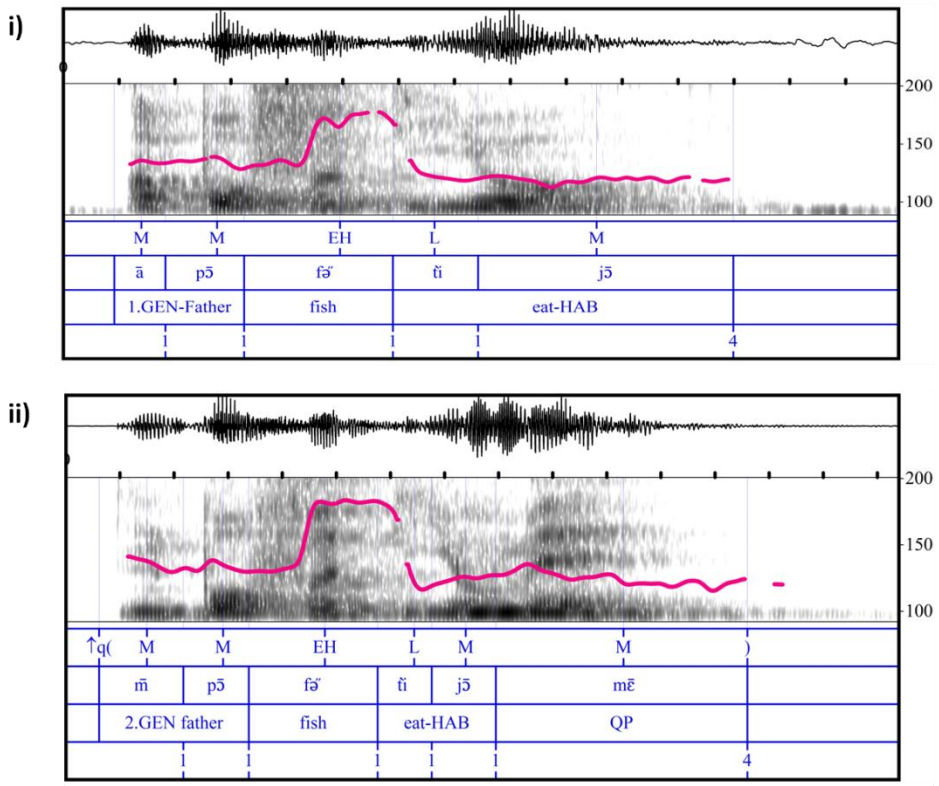

Figure 4.22: f0 contour of the declarative sentence [ā-pɔ̄ fə̋ tì jɔ̄] *my father eats fish*' (top panel) and its polar question counterpart [m̄-pɔ̄ fə̋ tì jɔ̄ mɛ̄] *does your father eat fish?*, (bottom panel) produced by a male speaker

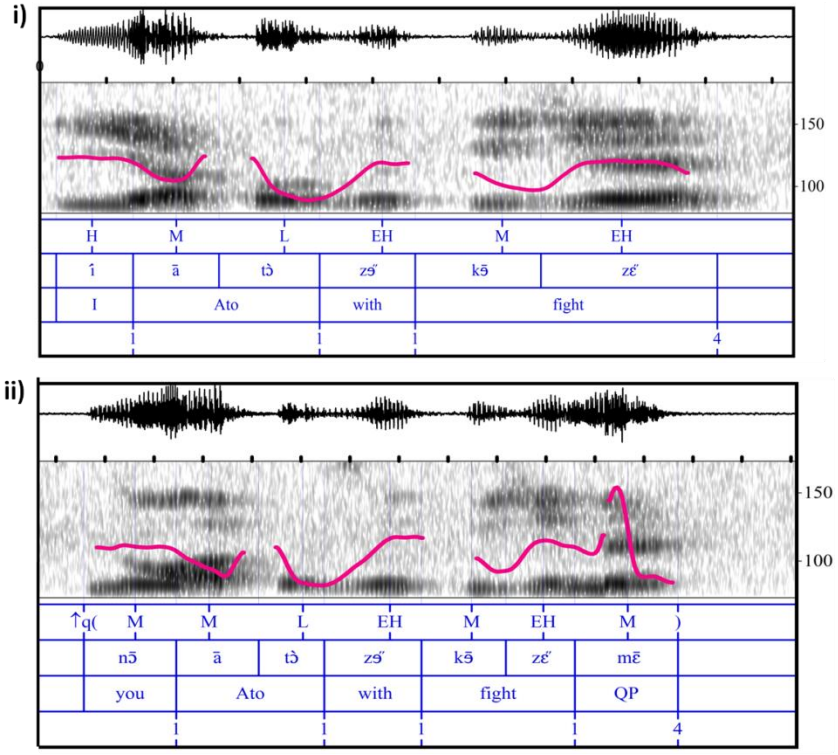

Figure 4.23: f0 contour of the declarative sentence [í ātɔ̀ zɔ̋ kɔ̄zɛ̋] (top panel) *I fought with Ato* and its polar question counterpart [nɔ̄ ātɔ̀ zɔ̋ kɔ̄zɛ̋ mɛ̄] *Did you fight with Ato*, (bottom panel) produced by a male speaker

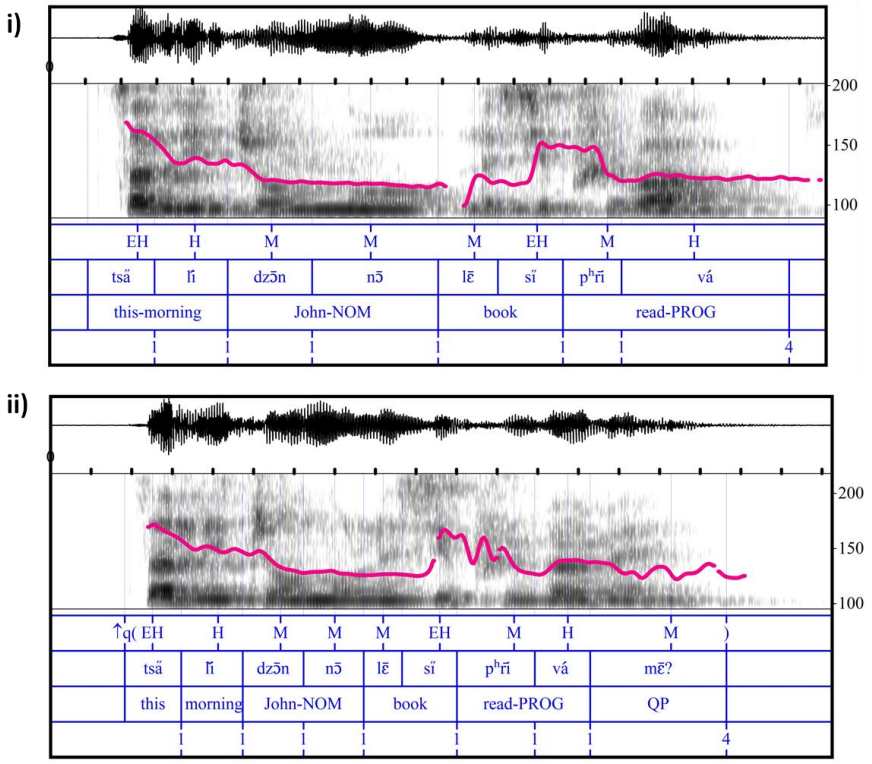

Figure 4.24: f0 contour of the declarative sentence [tsā́lí dzɔ̄n-nɔ̄ lɛ̄sǐ́ phrīvá] '*John was studying this morning'*, and its polar question counterpart [tsā́lí dzɔ̄n-nɔ̄ lɛ̄sǐ́ phrīvá mɛ̄] '*was John studying this morning?'*, produced by a male speaker

The average f0 of syllables with the same tones at different sentential positions shows the presence of temporal declination in both types of sentences. For instance, for the declarative sentence in **Figure 4.22**, the average f0 of the first syllable with an M tone is around 134 Hz, while the M tone in the final syllable has an f0 of 118 Hz. Similarly, in the question sentence, the initial M has an average f0 of 138 Hz, and the average f0 for the final M is 124 Hz. Figure 4 shows the time normalized mean f0 values of declarative and a yes/no question. In both sentences, the second R tones are realized with a lower f0 compared to the first R. Similarly, f0 for the M tone decreases when they occur later in the sentence. This confirms that suspension of downtrends is not a marker of yes/no questions in language as they are subject to phonetic downtrend effect just like declaratives. The downtrend effect present in yes/no questions and declaratives is shown with time normalized average f0 values of a pair in **Figure 4.25**.

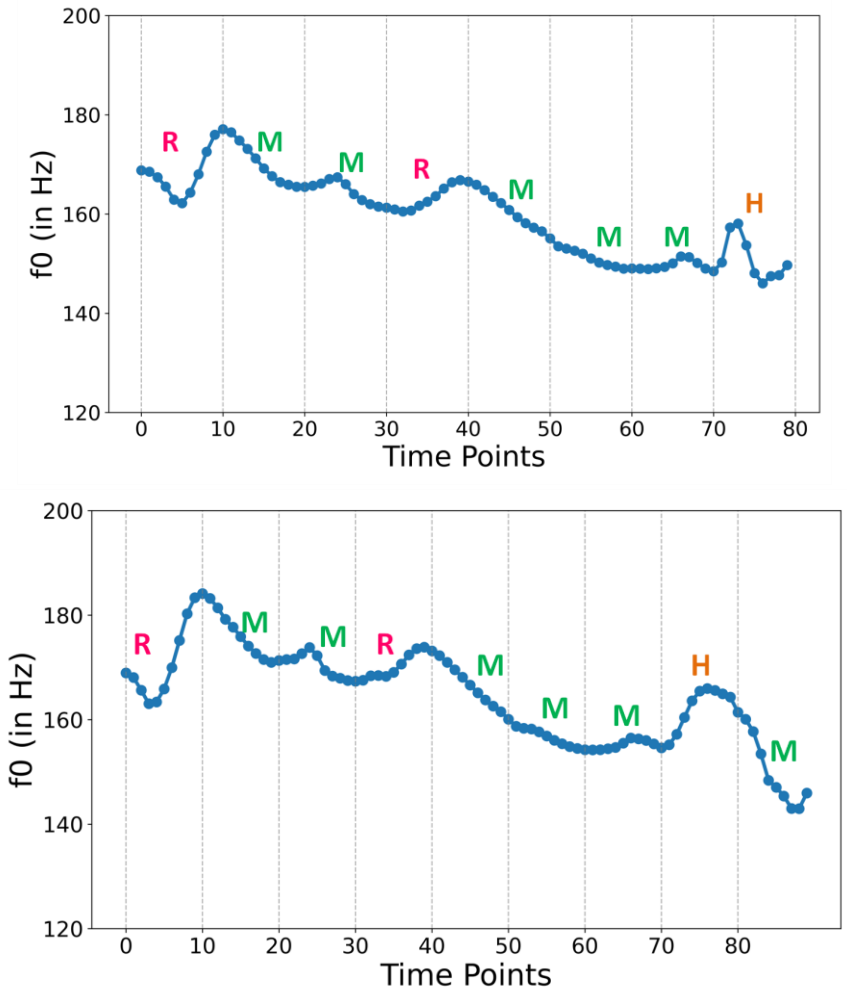

Figure 4.25: time normalized average f0 of the declarative sentence [nălə̄ ʧɛ̄tă mərā hūvá]' *the cat is chasing birds outside'* (top panel), and the yes/no question [nălə̄ ʧɛ̄tă mərā hūvá mɛ̄] '*Is the cat chasing birds outside?' (bottom panel)* of all tokens by five speakers. The lexical tone of each syllable is labeled with tonal notations. Each 10 points in the x-axis corresponds to one syllable.

A comparison of the pitch track of declarative sentences and their polar question counterparts showed that the f0 in the question utterance is higher than that of the declaratives in all points of the contour. Plotting the time normalized average f0 values of both sentences for better visualization confirms this observation:

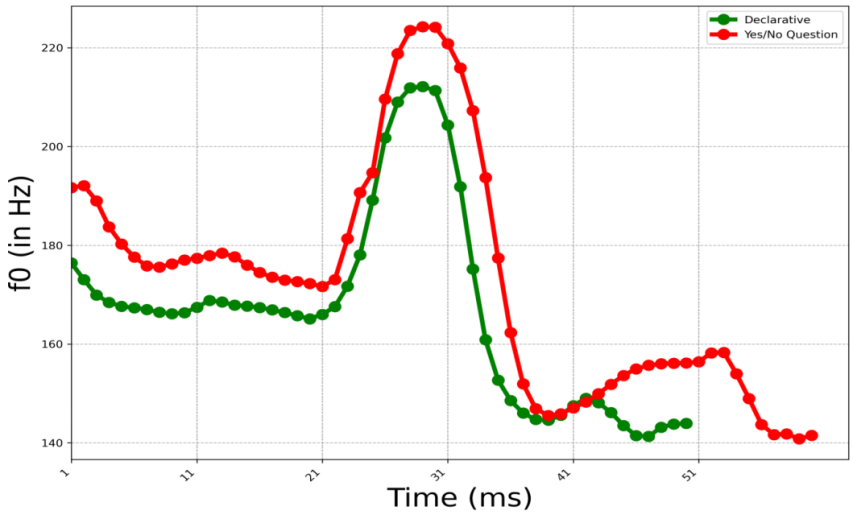

Figure 4.26: time-normalized average f0 values of the declarative [ā-pɔ̄ fə́ tì jɔ̄] 'my father eats fish' and its polar question counterpart [m̄-pɔ̄ fə́ tì jɔ̄ mɛ̄] 'does your father eat fish*?'*, of all tokens by five speakers

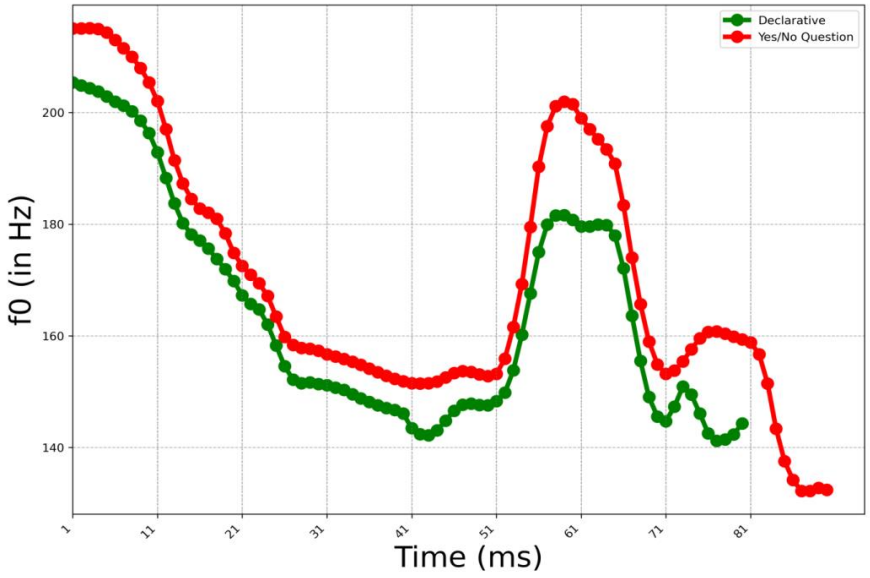

Figure 4.27: Comparison of time normalized average f0 of the declarative sentence [tsálí dzɔ̄n-nɔ̄ lēsí́ phrīvá] '*John was studying this morning'*, and its polar question counterpart [tsálí dzɔ̄n-nɔ̄ lēsí́ phrīvá mɛ̄] '*was John studying this morning?'*, of all tokens by five speakers

Figure 4.26 and **4.27** plot the f0 contours of two different declarative and polar question pairs. The question utterances are produced in a higher pitch register in both instances. This pitch-raising is consistently found in all the pairs examined in this study. A comparison of average intensity values of the two sentence types also suggested a higher intensity in yes/no questions.

In order to verify that the observed pitch register differences in the two types of sentences are statistically significant, we conducted a repeated measure ANOVA to analyze the difference in 'f0' values between 'Declarative' and 'Yes/No Question' sentence types, with 'speaker' as the within-subject variable. A one way repeated measure ANOVA was also performed to analyze the differences in ‘intensity’ values. The model was fit using the AnovaRM function from the statsmodels library, with 'f0' and ‘intensity’ as the dependent variables, 'speaker' as the subject identifier, and 'Sen_Type' as the within-subject factor. The results of repeated measures ANOVA show that there is a statistically significant difference in 'f0' of approximately 10 Hz ($F(1.0, 5.0) = 28.371368819293238$, $p < 0.05$), and 'intensity' ($F(1.0, 5.0) = 10.987621779415335$, $p < 0.05$) between 'declarative' and 'yes/no question' sentences (**Figure 4. 28**).

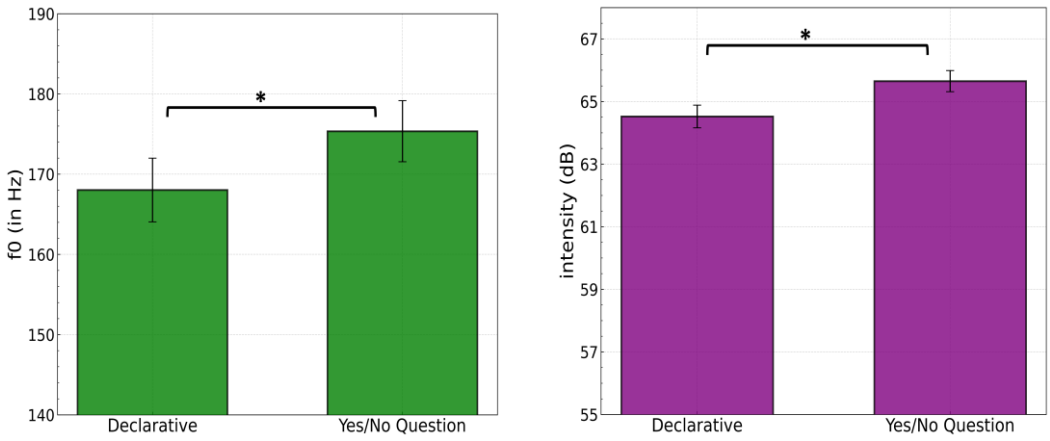

Figure 4.28: draws the results of the repeated measure one-way ANOVA showcasing a comparison between declarative sentences and polar questions in terms of f0 and intensity. An (*) indicates the significant pairs; (I) shows the trend for fundamental frequency (f0 in Hz) and (II) intensity (in dB)

4.4.2. Wh Questions:

Wh- questions in Chokri are constructed with the in-situ placement of the question words. Prosodically, these utterances maintain the underlying tonal specification of the syllables. Their identity as wh- question, therefore, seems to be marked primarily by morphological means, i.e., the use of question words.

Examples:

9. n̄-zukə̄ díp̀ə̀ ʧɔ́-vá
   2P.GEN-mother what cook-PROG
   'what is your mother cooking?'

10. tʰūmà tsə̀ díʧɛ́ vɔ́-zə́?
    Man that where go-PROG
    'where is the man going?'

Similar to yes/no questions, wh-questions also do not have intonation marking boundary tones. This can be seen in **Figure 4.29** to **4.31**, where the pitch tracks of different wh-question sentences are shown:

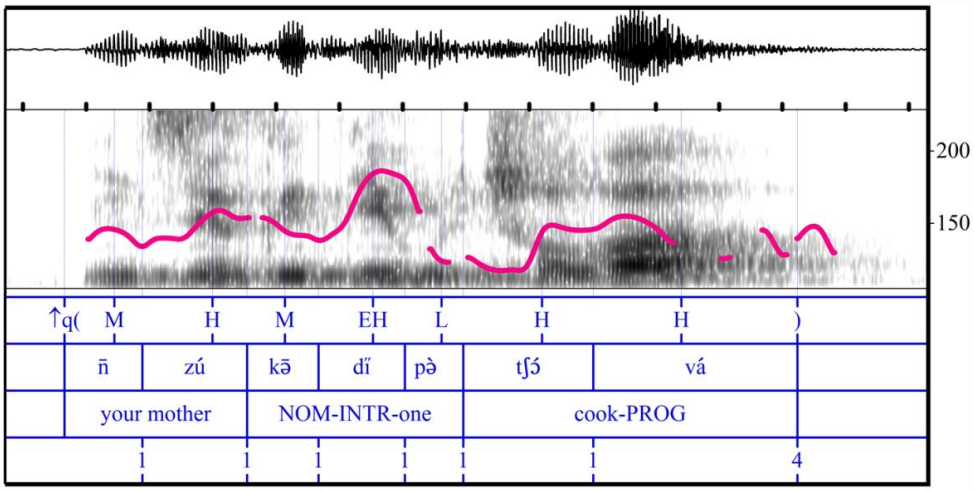

Figure 4.29: Pitch track of the sentence [n̄zu kədípə̀ ʧɔ́vá?] 'what is your mother cooking?', produced by a male speaker

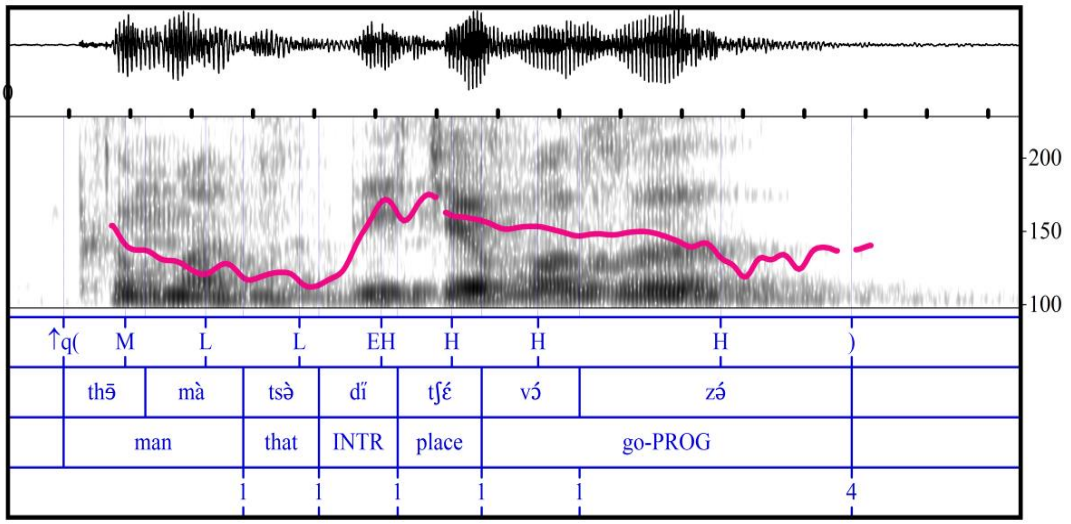

Figure 4.30: f0 contour of the wh-question [tʰə̄mà tsə̀ dǐtʃɛ́ vɔ́-zɔ́?] ‘where is the man going?’,produced by a male speaker

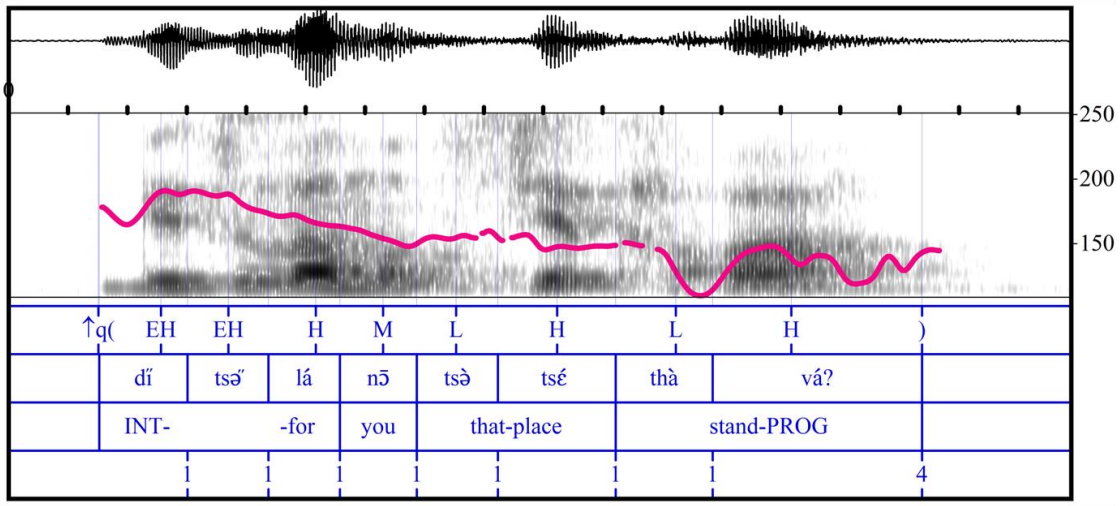

Figure 4.31: f0 contour of the wh-question [dǐtsə̋lá nɔ̄ tsə̀tsɛ́ thàvá?] ‘why are you standing there?’, produced by a male speaker

The repeated measures ANOVA shows that there is a statistically significant difference in 'f0' between 'declarative' and 'wh question' sentences ($F(1.0, 5.0) = 7.268006457631566$, $p < 0.05$) (**Figure 4.32**).

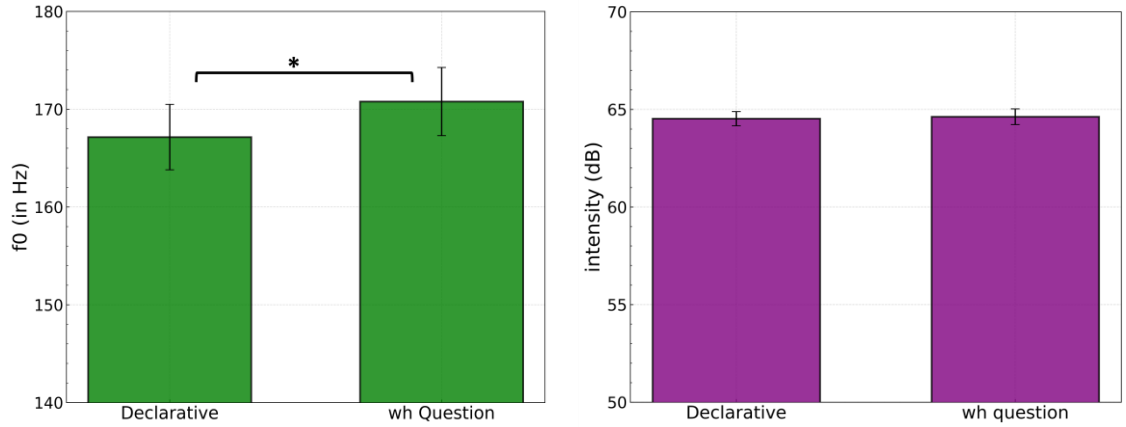

Figure 4.32: draws the results of the repeated measure one-way ANOVA showcasing a comparison between declarative sentences and wh questions in terms of f0 and intensity. An (*) indicates the significant pairs; (I) shows the trend for fundamental frequency (f0 in Hz) and (II) intensity (in dB)

4.4.3. Alternative Questions

Syntactically, alternate questions in Chokri are constructed by positioning the word 'or' / mɛ̄/ between the two elements of the alternative. For example:

11. ñɔ́ fɔ̋ ñ-nɔ́ mɛ̄ t^{h}ì
    You fish you-like or meat
    Do you like fish or meat?

12. nɔ́ ālú pūŋu m̄ɔ̀rī ʃ̀ɛ̀rɔ̄ thrḯ-tɛ́ mɛ̄?
    You potato five not six buy-PRF QP
    Have you brought five or six potatoes?

In terms of prosody, alternative questions do not share the same features as the other two types of question utterances analysed in this study. Unlike wh and yes/no questions, alternative questions do not undergo pitch register modification. These types of questions rely little on intonational features for marking their type. They are intonationally more similar to declarative sentences, and they are realized with similar f0 register. The underlying tones do not undergo any change in terms of their realization at the sentence level. The evidence for retention of underlying tonal specification of syllables throughout the utterances can be shown through their pitch tracks, as given in **Figure 4.33-Figure 4.34**.

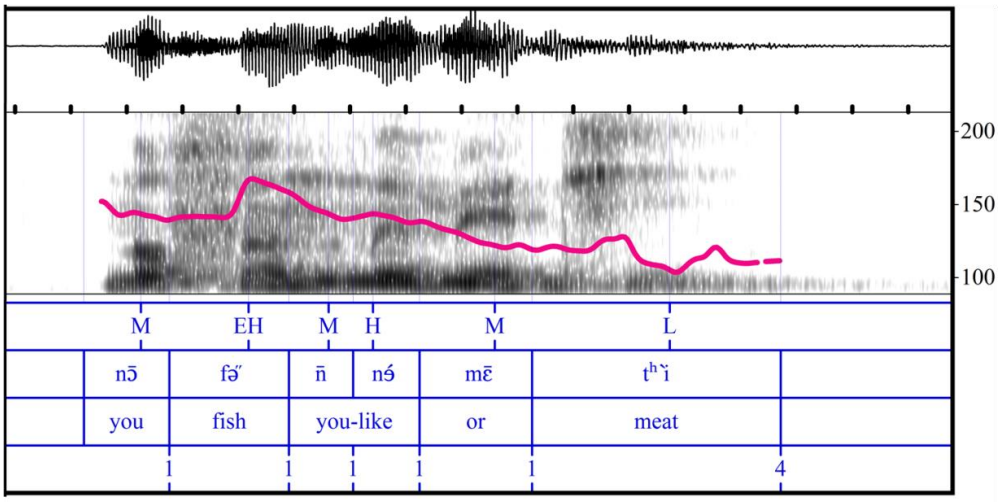

Figure 4.33: f0 track of the alternative question [n̄ɔ́ fə́ n̄-nɔ́ mɛ̄ tʰì] 'do you like fish or meat?', produced by a male speaker.

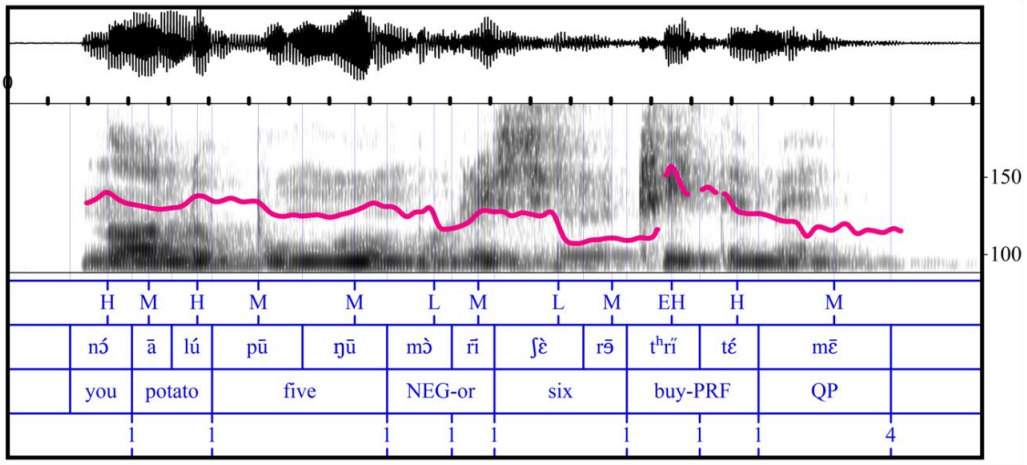

Figure 4.34: f0 track of the alternative question [nɔ́ ālú pūŋu ̄mɔ̀rī ʃɛ̀rɔ̄ thrí té mɛ̄?] 'have you brought five or six potatoes?', produced by a male speaker.

A repeated measures ANOVA was performed to check if there was a significant difference in terms of pitch and intensity between declarative and alternative question sentences. The results showed that there is no statistically significant difference in 'f0' (F(1.0, 5.0) = 0.08941835439570045, p = 0.7769479270621659) and intensity (F(1.0, 5.0) = 0.7641525069927713, p = 0.4220260851463583) between 'declarative' and 'alternative question' sentences.

4.4.4. Imperatives

All imperative utterances in Chokri are morphologically marked with the marker /tɛ̄/, which is placed in the utterance's final position. The language does not resort to prosodic cues for marking imperative utterances, suggesting that the function of indicating the sentence to be a command is exclusively carried out by the sentence-final particle.

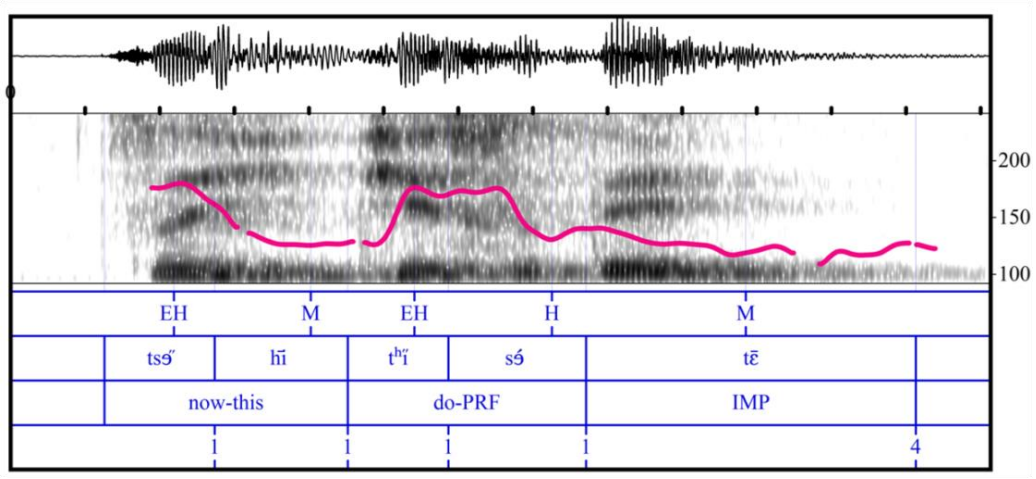

Figure 4.35: pitch track of the imperative sentence [tsə̋ hī thī́ sə́ tɛ̄] ‘do it now’, produced by a male speaker.

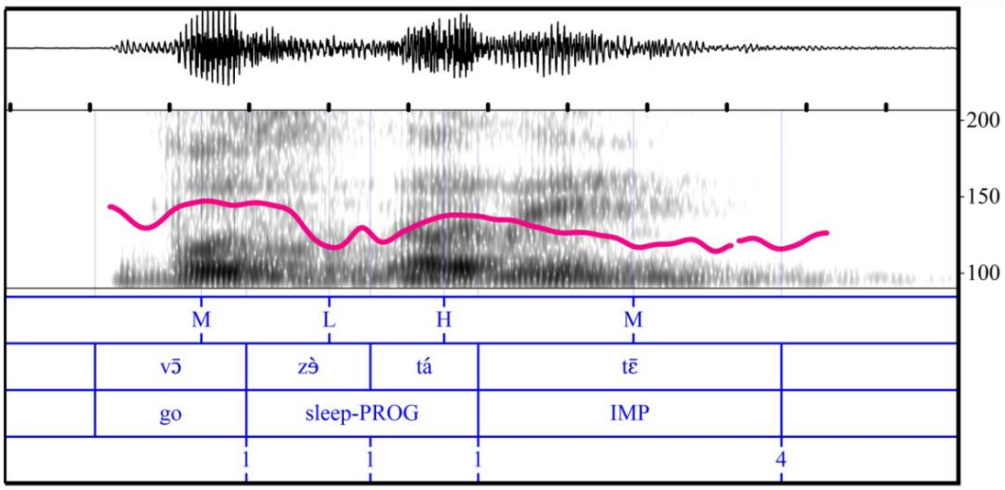

Figure 4.36: pitch track of the imperative sentence [vɔ́ zə̀-tá tɛ̄] ‘go to sleep’ produced by a male speaker.

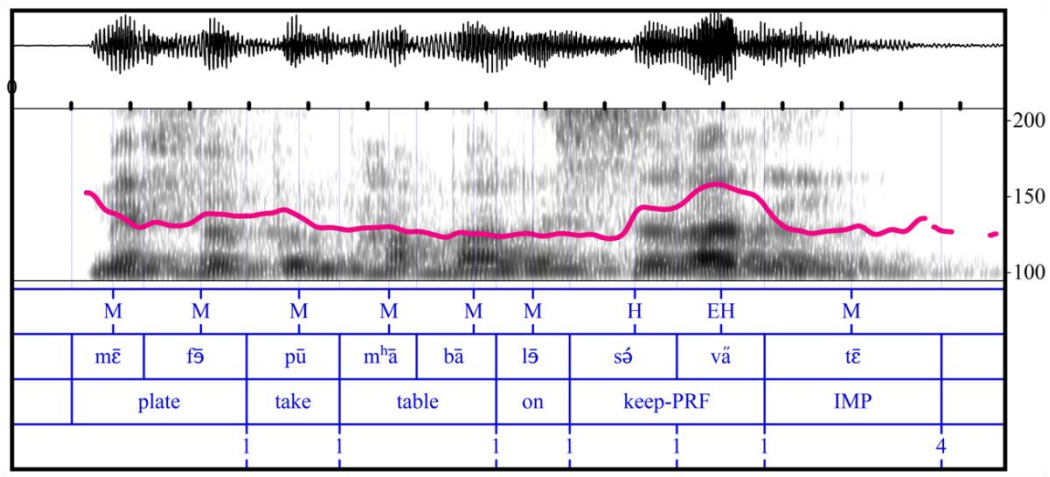

Figure 4.37: pitch track of the imperative sentence [mēfɔ̄ pū mʰābā lɔ̄ sə́vă̋ tɛ̄] 'keep the plate on the table', produced by a male speaker

4.4.5. Lists:

Like many other languages, list utterances in Chokri exhibit different prosodic patterns from other types of sentences. While there is no particular 'list contour' in the language, non-final elements in these sentences may constitute separate perceivable prosodic units. They are identifiable through the final syllable lengthening and a pause after the penultimate element of the list. The perceivable juncture and final lengthening are intonational cues for ips constituted by on-final list elements in the language. In **Figure 4.38** the non-final elements /rāsɛ̋/ 'fruit' /gāɲő/ 'curry' and /mētʰɔ̀nɔ̄ zə́/ 'milk' can be seen having lengthened final syllables.

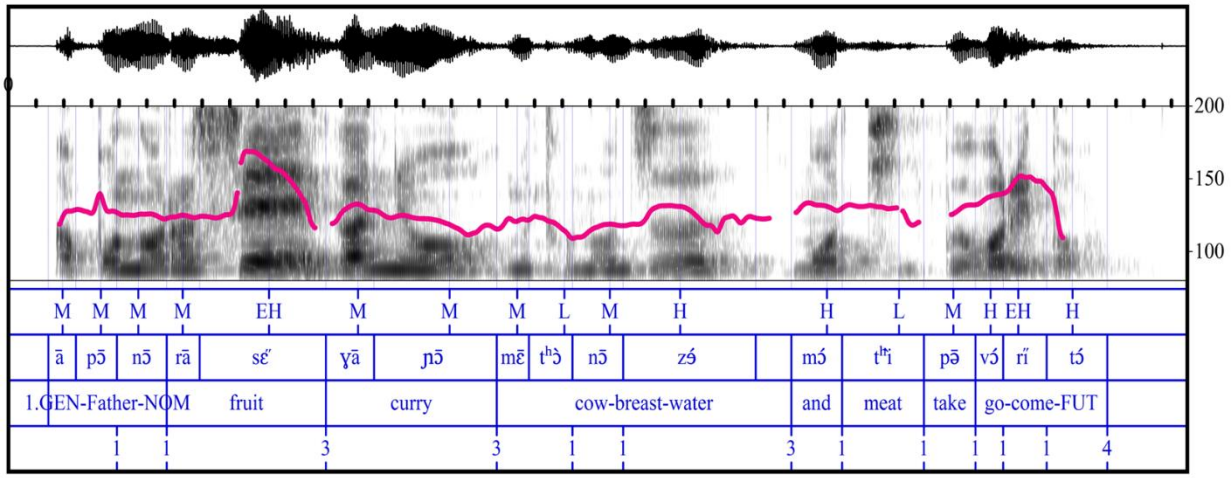

Figure 4.38: f0 contour of the list utterance /ā pɔ̄ nɔ̄ rāsɛ̋ gāɲő mētʰɔ̀nɔ̄ zə́ mə́ tʰì pə̄ və́rĭ̋ tə́/, *my father will bring fruits, curry, milk and meat*' produced by a male speaker

4.5. Discussion and Conclusion

The primary intonational marker for question sentences in both languages is pitch register raising. Despite sharing intonational features with related non-tonal languages through the prominent presence of phrasal tones, Sylheti does not have boundary tones that are indicative of yes/no questions. Rather, it uses a prosodic mechanism that is prevalent in most tonal languages, suggesting its transitional status as a tonal language from a language family that is not prototypically tonal. Although Chokri uses the same prosodic marker for marking questions, the lack of a boundary tone or a superimposed intonational tone is more likely due to the requirement of preserving meaning contrasts encoded in lexical tones of each syllable.

The pitch raising is a common intonational mechanism in question utterances in both intonation-only and tonal languages. In many languages, however, this is realized as a localized effect. In a large number of non-tonal languages, pitch register raising is present towards the end of question utterances in the form of a rising or H% boundary tone (Bolinger, 1972). Register raising in questions is well-attested in tonal languages as well. These include Thai (Luksaneeyanawin, 1998), Standard Mandarin (Shen, 1992; Shih, 2000), Tianjin Mandarin (Zhang and Lahiri, 2021), as well as African tonal languages like Xhosa (Jones et al., 1998), Northern Sotho (Zerbian, 2006). Just like intonation-only languages, raised pitch registers are found to be localized in many tone languages. In Cantonese, a High right boundary tone induces a higher f0 in utterance final tones (Ma et al., 2006). In Moro, polar questions are distinguishable from declaratives from the higher f0 in the early parts of the utterances. Examples of global register raising come from languages like Akan (Kügler, 2017), Northern Sotho (Zerbian, 2006), and Jita (Downing, 1996). The overall upward shift of f0 scaling of these languages resembles Chokri and Sylheti, where it is a formalized prosodic mechanism instead of a phonetic change. Gussenhoven (2004) is of the view that such register modifications can be considered discrete as they are consistently employed for specific linguistic meanings. In the AM framework of pitch range/register changes the intonational strategies for linguistic meaning in tonal languages are considered the same as the pitch range manipulation for paralinguistic meanings. Following Bruce and Garding's (1978) concepts of 'statement line' and 'focal line,' Ladd (2008) suggests that the range within which specified (lexical and/or intonational) tones occur may change across and within utterances. He calls this 'tonal space' and states that in case of

variations in the tonal space for post-lexical meaning, AM's account of intonational phonology will "require both tonal specifications and descriptions of how pitch range can be modified." The observed pitch register modifications in the Chokri and Sylheti can be incorporated into their respective intonational phonology as follows:

Sylheti:

Raised Register: question utterances

Chokri:

Raised Register: yes/no questions and wh questions

As register raising is the only tonal feature used for marking question utterances in the languages under study, it is important to devise a way to encode this phonological intonation mechanism in the annotation of speech in ToBI systems. A notation **↑q(.....)** is proposed for this purpose and placed in the tonal tier, wherein the parts undergoing register raising will be enclosed within brackets. As in the languages under study, the whole IP is realized with a higher pitch, and it is placed at both boundaries of the tonal tier. Since the tonal tier carries information about the tonal specification, the raised f0 symbol in this tier will effectively denote the phonological specification of the tonal register raising as well. A sample of the same is shown in the figure below:

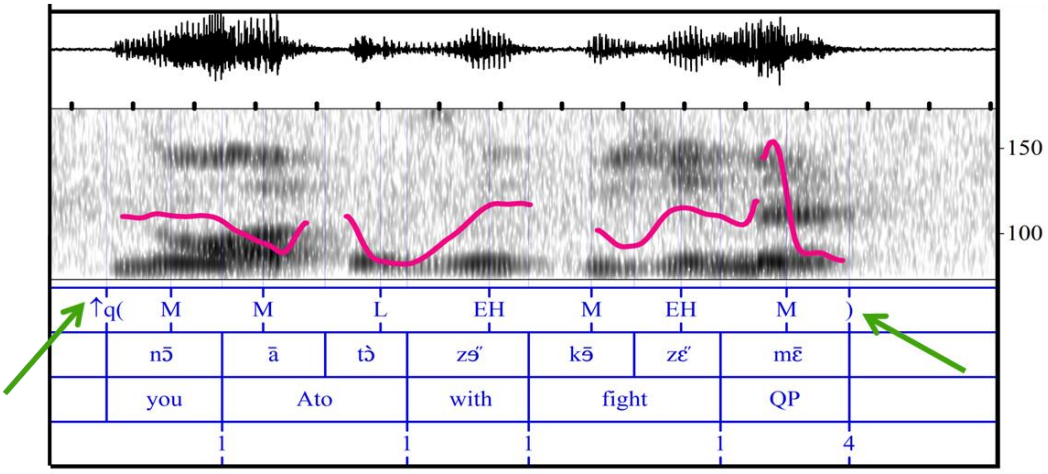

Figure 4.39: f0 track and annotation of the Chokri yes/no question /[nɔ̄ ātɔ̀ zɘ̋ kɘ̄zɛ̋ mɛ̄] '*Did you fight with Ato'* produced by a male speaker. The **↑q(.....)** in the tonal tier indicates that the f0 values of all the tones are realized with higher scaling.

Another important finding of this study is distinctive list prosody that creates striking differences between list and non-list utterances. In Sylheti, apart from having a specific intonation contour, non-final elements in lists also create individual prosodic units.

Formation of prosodic domains by non-final entities is also characteristic of Chokri list sentences; however, the pitch here does not participate in the same way.

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