

# PROSODIC PROMINENCE OF SWAHILI TU IN POLAR INTERROGATIVES

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## ABSTRACT

Prosodic patterns of the exclusive particle TU in Swahili polar interrogatives are examined. TU is realised with a pitch boost and appears in both sentence-final and non-final positions. Interrogatives overall display sentence-final falling intonation, resulting in a prosodic mismatch with sentence-final TU.

We recorded 30 stimuli sentences with 4 or 5 words varying in the position of TU from six speakers of Zanzibar Swahili. The Praat algorithm was used to extract  $f_0$  and the duration of the penultimate syllable of each word as well as that of TU and the ultimate syllable of a final word. Results show that the prosody of interrogatives differs from declaratives by raising  $f_0$  of the final word. TU is always associated with a pitch boost regardless of its position. Longer durational cues in sentence-final TU were used by two speakers, showing inter-speaker variation.

**Keywords:** Sentence Prosody, Exclusive Particle, Interrogatives, Zanzibar Swahili

## 1. INTRODUCTION

This paper aims to answer two questions related to the yes-no question patterns in Swahili. First, we investigate how sentence intonations are realized in declaratives and interrogatives. Secondly, we further investigate the intonation pattern of sentences including the exclusive particle TU ‘only, just’ which 1) occurs in a phrase or sentence-final position and 2) bears an inherent high pitch. Our main interest lies in investigating the intonational distinction between statements and corresponding polar questions in sentences that contain the particle TU that is required to display pitch boost.

Swahili is a stress/accent language while many Bantu languages are tonal. Stress in Swahili is accompanied by length and a falling tone and is normally realized on the penultimate syllable of a word or phrase [1], [2]. The intonation of Swahili varies depending on sentence types, but some common features can be used when describing the intonation system of yes-no polar questions [1].

In the descriptions of intonation of questions in Swahili polar questions are marked with stress and a falling tone on the final syllable in [2], whereas a phonetic-based description in [1] mentions both the penultimate and ultimate syllables; (a) the stressed penultimate syllable is realized with a mid, a high-falling, or a mid-rising pitch, (b) the final syllable is associated with a high falling pitch or a low pitch, (c) the final syllable may be longer in the high falling pitch cases. [3] and [4] report that the initial element of an interrogative sentence receives a high pitch. These studies indicate that polar questions may have a falling pitch on the final syllable, but our data suggest that this pattern is not universal non-falling, non-low pitch pattern also marks polar questions (cf. [5]).

A summary of intonation in African tonal languages in [6] demonstrates that most languages use falling intonation with a L boundary tone in polar questions. Swahili is a stress language, and in our data at least, polar questions do not end with a L boundary tone when compared with declaratives.

The rest of the paper is structured as follows. In section 2, methods of data collection are described. The results concerning the intonation of polar questions with and without the exclusive particle TU in section 3 demonstrate the prosodic effect of TU: pitch boost regardless of its position in a sentence. The paper concludes with a discussion about the interplay between intonation of sentence types and pitch realization of a particle.

## 2. METHODS

### 2.1. Stimuli

For stimuli, three conditions were considered: No-TU, Non-final-TU, and Final-TU. The base structure of all stimuli sentences is S + V + O. The No-TU condition sentences exclude the TU particle (1a, 2a). Sentences with TU have two conditions: the Non-final-TU condition, S + V + *tu* + O in (1b, 2b), and the Final-TU condition, S + V + O + *tu* (1c, 2c). Each condition contains 5 types of object DP composed of a noun and an adjectival modifier, which differ from one another in the vowel quality of the sentence-final syllable. All conditions had two sentence types: polar interrogatives and declaratives.

Overall, 30 items were created: 3 TU-related conditions x 5 object DP types x 2 sentence types.

(1) Examples of polar interrogative sentences

- a. No-TU condition with final [e] vowel  
*Juma a-li-wa-fuata wa-toto wa-nane?*  
Juma 3SG-PST-3PL-follow 2-child 2-eight  
'Did Juma follow eight children?'
- b. Non-Final-TU condition with final [e] vowel  
*Juma aliwafuata tu watoto wanane?*  
'Did Juma just follow eight children?'
- c. Final-TU condition with final [e] vowel  
*Juma aliwafuata watoto wanane tu?*  
'Did Juma follow only eight children?'

(2) Examples of declarative sentences (for control)

- a. *Juma aliwafuata watoto wanane.*  
'Juma followed eight children.' (cf. 1a)
- b. *Juma aliwafuata tu watoto wanane.*  
'Juma just followed eight children?' (cf. 1b)
- c. *Juma aliwafuata watoto wanane tu.*  
'Juma followed only eight children?' (cf. 1c)

2.2. Participants and Recordings

Six native speakers of Zanzibar Swahili, evenly divided by gender, were asked to read 30 stimuli sentences twice, resulting in 60 tokens per speaker. At the time of the recording, the age of participants ranged between 27 to 49. All participants were compensated for their time.

All recordings were conducted in a quiet room in Zanzibar, Tanzania, using Audacity on a MacBook computer set at 44.1kHz sampling rate and 16 bit depth.

2.3. Annotation and analysis

The recordings were processed and annotated using Praat [7]. The vowel of the target TU and the vowel of the penultimate syllable of each word is annotated as in Figure 1. For example, the [u] vowel in the penultimate syllable of the second word *alikul*a 'he/she ate' is marked with 2. The fourth word is further annotated into 4P that stands for the penultimate syllable, and 4U for the ultimate (final) syllable. Three acoustic variables (maximum F0, minimum F0, and duration) from each annotated segment were extracted using the Praat algorithm. This data was then processed using R [8].

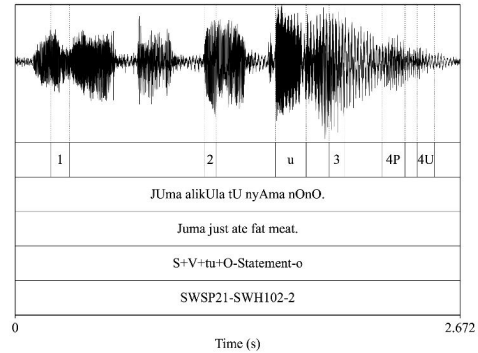


Figure 1: An example of the annotated sentences: *Juma alikula tu nyama nono.* 'Juma just ate fat meet' The annotated vowels are capitalized in Swahili.

3. RESULTS

3.1. Interrogatives without TU: No-TU condition

The prosodic differences between declaratives and interrogatives are reported in this section. In most tokens (n = 39 out of 40) produced by four speakers (SWH102, 103, 104, 106), a relatively higher pitch of the final word is observed in interrogatives than in declaratives. The remaining two speakers did not display any pitch differences, resulting in the identical intonation between the two sentence types.

The higher pitch of a final word has a variable position. Three participants (SWH103, 104, 106) placed an emphasis on the ultimate syllable of the final word. As Figure 2 shows, the ultimate syllable of the fourth word (4U) in interrogatives is produced with a higher pitch compared to the penultimate syllable of that word (4P). The participant SWH102 produced the penultimate syllable in the final word in interrogative sentences with a higher pitch than in declaratives (see Figure 3).

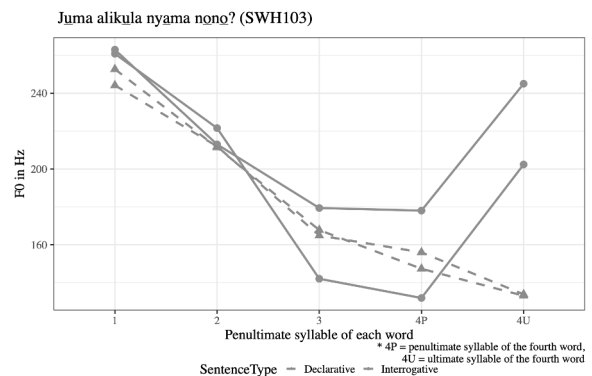
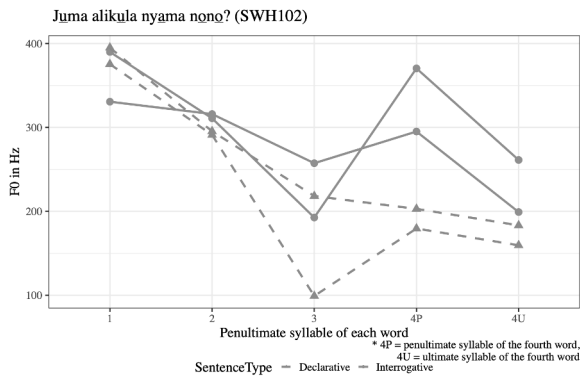


Figure 2: Pitch transition for no-TU sentences of SWH103. Dotted lines are declaratives and solid lines are interrogatives.

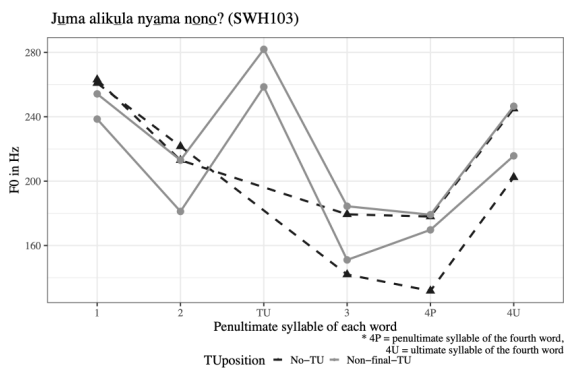


**Figure 3:** Pitch transition for no-TU sentences of SWH102. Dotted lines are declaratives and solid lines are interrogatives.

The remaining two speakers (SWH101, 105) show intonation patterns, in which interrogatives have a falling intonation on the final word, which does not differ from corresponding declaratives.

### 3.2. Interrogatives with a non-final TU

As per [9], Swahili TU triggers pitch boost on itself. Excluding the pitch boost of TU, interrogatives in the Non-final TU condition have the same intonation pattern as the no-TU condition. As shown in Figure 4, after the pitch boost triggered by TU, the pitch of penultimate syllable *nyama* in the Non-final-TU condition (solid line) returns to the level comparable to the No-TU condition (dotted line).



**Figure 4:** Pitch transition for No-TU and Non-final TU conditions (SWH103): *Juma alikula nyama nono?* ‘Did Juma eat fat meet?’ (No-TU in dotted lines) vs. *Juma alikula tu nyama nono?* ‘Did Juma just eat fat meet?’ (Non-final-TU in solid lines).

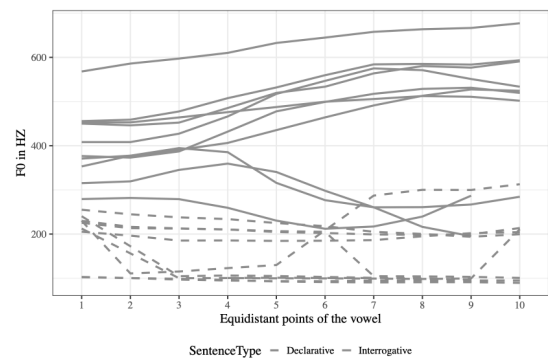
### 3.3. Interrogatives with a final TU

Since the prosodic cue for interrogatives in Swahili depends on the stress of the final word, due to the prosodic prominence of TU, it would be difficult to produce/perceive the F0 difference in the final TU between declarative and interrogative. In addition to

the F0 difference observed in no-TU polar interrogatives, the duration of the final TU is used by three speakers as an alternative prosodic cue for interrogatives.

#### 3.3.1 F0 differences in the final TU

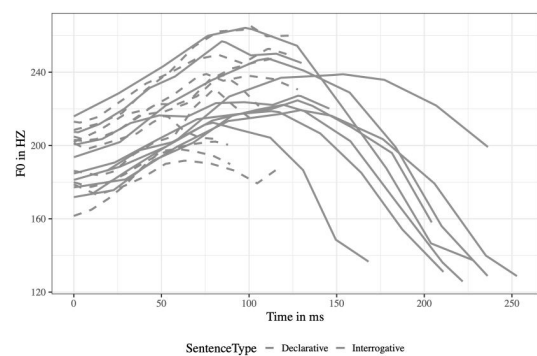
Using R, we modeled the pitch contour of the final TU vowel with the F0 of 10 equidistant points extracted from the vowel interval. As shown below in Figure 5, the participant SWH102 uses the F0 final TU vowel to differentiate Final-TU interrogatives from Final-TU declaratives.



**Figure 5:** Pitch contours by normalised duration of the vowel of the final TU of SWH102. Dotted lines for declaratives and solid lines for interrogatives.

#### 3.3.2 Durational differences in the final TU

Two speakers (SWH103, 104) utilized the duration of the final TU as an alternative prosodic cue for interrogatives. Figure 6 shows that SWH103 produces the final TU in interrogatives longer than in declaratives.



**Figure 6:** Pitch contours by non-normalised duration of the vowel of the final TU of SWH103. Dotted lines for declaratives and solid lines for interrogatives.

For analysis, the maximum and minimum F0 of each vowel interval was extracted, alongside the F0 of 10 equidistant points throughout the interval. The F0 values are plotted against their relative extracted time (extracted time – start time). This durational

difference is also observed in the Final-TU interrogatives in three tokens out of ten spoken by SWH106.

In addition to the durational difference, a difference in pitch fall is observed in the final TU spoken by SWH103, 104, and 106. The three speakers produce a larger pitch fall in the vowel of the final TU in interrogatives than in declaratives.

## 4. DISCUSSION

### 4.1. Two groups in the No-TU condition

The results show that speakers can be divided into two groups based on how they produce the interrogatives without TU. The first group emphasizes the final word, either on the ultimate syllable as in *nonó* (SWH103, 104, 106) or penultimate syllable as in *nóno* (SWH102). Since Swahili is a language that generally places the accent on the penultimate syllable of each word, placing a higher pitch on the penultimate syllable suggests a parsimonious strategy for distinguishing interrogatives from declaratives.

When speakers place the accent on the ultimate syllable instead, the principle of accent assignment in Swahili is violated. It is interesting that a number of speakers utilize this pattern of interrogative intonation. This ultimate-accent pattern for interrogatives might be attributed to the influence of rising-intonation of English interrogatives, but this account is not reliable as the speakers who display this intonation do not belong to the younger group of speakers (age 29, 42, and 49). As such, we suggest that the constraint assigning prominence to the penultimate syllable of a word may not be an absolute requirement in Swahili prosody.

As no participant puts an emphasis on the antepenultimate syllable when the final word consists of three syllables, the prosodic domain where the accent can be realized in Swahili is assumed to be limited to the final two syllables.

The second group consists of speakers who do not differentiate declaratives and interrogatives in terms of prosody (SWH101, 105). This unmarked intonation for interrogatives could stem from sociolinguistic or pragmatic reasons; speakers who use this intonation might ask questions with a context-based approach to avoid using a direct question or a command. Interrogatives of African tonal languages have been reported to have similar prosody to declaratives [6]. Our study shows that a non-tonal African language, Swahili, could also exhibit such a pattern.

### 4.2. Interrogatives with TU

With regards to TU, we conclude that the intonational characteristics for interrogatives with TU are not obligatory but optional. For those who differentiate interrogatives from declaratives by intonation, the prosodic prominence of TU interferes with the intonational differentiation; since TU is monosyllabic, a speaker cannot put an accent on any other syllable as they can do in *nonó*. Three speakers, that put an accent on an ultimate syllable of the final word for interrogatives without TU, use the duration of TU or its pitch fall as alternative cues for the interrogatives with TU. On the other hand, another speaker, that produces a higher pitch on a penultimate syllable of the final word for interrogatives without TU, uses only F0 even when asking questions with TU. These inter-speaker variations indicate that interrogatives with TU are realized in several ways or sometimes become hidden in terms of prosody.

More discussions on the durational difference and pitch fall are required. These characteristics are observed in tokens spoken by SWH103, 104, and 106, and both characteristics never conflict with each other. When duration is lengthened, pitch is also lowered to relieve any articulatory burden. Vice versa, when pitch is lowered, duration is also lengthened to avoid a sudden pitch fall. At this juncture, it is still unclear as to which constitutes the main attempt and which belongs to the quadratic effect.

## 5. CONCLUSION

The question prosody of Swahili with or without the exclusive particle TU has been investigated in this paper. We found that (a) interrogatives end with a high boundary tone compared to declaratives, and (b) TU is realised with a pitch boost. When TU is non-final, the intonation patterns of interrogatives are identical except for the pitch boost. When TU is sentence-final, (c) the pitch of TU is higher in interrogatives than in declaratives, and (d) TU is realised longer with a clear falling contour.

## 6. ACKNOWLEDGEMENTS

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