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DIFFERENCES OF AGE AND GENDER IN PITCH RANGE MODULATION IN *YES-NO* QUESTIONS IN EKEGUSII

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The aim of the paper was to describe pitch range modulation in *yes-no* questions in Ekegusii. In addition to describing the realization of intonation-related features like upstep and fundamental frequency (F0) in these questions, the paper has related this realization to the age and gender variables, to show how varied speakers' speech is acoustically different. Data were collected from 24 purposively selected native speakers of Ekegusii (12 male and 12 female of different age groups). They were analysed within the framework of the Autosegmental-Metrical Theory. Two findings emerged from the analysis. First, the male speakers' pitch range modulation was realised at an F0 bottom line of 126 Hz and top line of 242 Hz while the female speakers' F0 bottom line was 225 Hz and top line 260 Hz. Second, although female speakers produced the utterances at higher F0s than their male counterparts did, there were variations across the four age groups of male and female speakers. The largest variation in F0 occurred among the youth and the smallest among the children. The advanced-aged female group of participants and the male children's group produced the highest F0s while the middle-aged groups (both the female and the male) produced the lowest F0.

Key words: age, Ekegusii, fundamental frequency, gender, pitch range modulation, *yes-no* questions

1. INTRODUCTION

The paper is an acoustic analysis of the influence of age and gender in pitch range modulation in *yes-no* questions in Ekegusii speech. It specifically identifies and describes intonation features in *yes-no* questions in the language. *yes-no* questions in Ekegusii are utterances that do not have a specific question word marking them, either at their beginning or end. Phonetically, such utterances

have the same sound sequences as their declarative counterparts. Consider the following examples:

(1) /nkwaɣenda moɣondo/ *nkwagenda mogondo* 'You went to the shamba /did you go to the shamba?'

(2) /neßeter*er*eti moʧiʧe na ßa*r*aßwo/ *nebetereretie mochiche na barabwo* 'You must come with them/must you come with them?'

The utterances in (1) and (2) can have a declarative or an interrogative meaning depending on the nature of the interaction of intonational tones and the F0 range used in their production.

The interaction of intonational tones like H (high) or L (low) in the form of upstep, on the one hand, and H% or L% boundary tones, on the other hand, in *yes-no* questions are regarded in this paper, following Hyman and Kemmonye (2008: 271), as "the categorical intonation pitch features…". Upstep, according to Katamba (1989: 207), is "the raising of the pitch of a tone so that it is phonologically a step higher than the preceding token of the same tone" in an utterance. A boundary tone, on the other hand, is one that demarcates the right or left edge of an intonation phrase. Crystal (2008: 59) points out that a boundary tone is "In some analysis of INTONATION, a TONE typically positioned at the EDGE of a PHRASAL CONSTITUENT. […] a % symbol is used to show that a tone associates with the EDGE syllable of a phrase (H%, L%)". The right-edge boundary tone symbolised as H% or L% indicates that the utterance ends in either a high (H) or a low (L) tone, while the left-edge boundary tone symbolised as % H or % L signals an H or a L tone at the utterance onset.

In addition to describing upstep and boundary tones, the paper also uses the voice fundamental frequency to account for pitch modulation in the *yes-no* questions. According to Féry (2017: 20), "Pitch (F0) is measured in Hertz, that is, the number of periods per second of an acoustic wave". Crystal (2008: 204) notes that F0 "is of particular importance in studies of INTONATION, where it displays a reasonably close correspondence with the PITCH movements involved".

The description of the production of the above intonation-related features in *yes-no* questions in Ekegusii in this paper revolves around age and gender-determined differences. The choice of this topic was motivated by Féry (2017: 20-21) who observes that "A woman's voice is typically higher than a man's voice,

because vocal folds are thinner and shorter in women and, as a result, they vibrate more quickly. On average, young women speak at 220 Hz and young men at 130 Hz." Again, as Ladefoged and Johnson (2015: 254) observe, "the pitch of voice usually indicates whether the speaker is male or female and, to some extent what his or her age is". The consideration of these variables was also motivated by an earlier description of declarative utterances in Ekegusii by Komenda et al. (2020: 133) which reveals that a speaker's pitch register[1] is determined by their age. Therefore, since individual speakers are deemed to have their own register, whether they are female or male, young or old, the paper also seeks to establish what Ekegusii speakers' F0 top lines and bottom lines in *yes-no* questions are.

2. METHODOLOGY

This section describes the sample of participants, the nature of the data, and the data collection and analysis procedures.

2.1 Participants

Data were from 24 native speakers of Ekegusii who were purposively sampled. These were people well known to one of the researchers. Since the main purpose of the research was to show the pitch differences in different speakers, 12 male and 12 female participants were selected. This number was considered adequate following Ladefoged's (2003: 14) suggestion for the use of "12 or even 20 members of each sex" in a phonetic recording of data.To minimize speaker homogeneity, the participants selected represented varied age categories (children, the youth, middle-aged and advanced-aged). All the participants selected resided in their rural Riangabi village, Kisii County, and were, at the minimum, able to read Ekegusii utterances.

[1] According to Féry (2017: 21), "The term *pitch register* often means the same as *pitch range*, namely an interval in the F0 used by S in general, or in particular sentences". It is specifically "the F0 domain that their voice covers".

2.2 Nature of the data

The data collected consisted of four *yes-no* questions. From these, 288 utterances were generated since the 24 participants uttered each of the four questions three times (24*4*3=288). Three repetitions were preferred as they gave both the participants and the researchers an opportunity to choose the most naturally articulated utterance. The four *yes-no* questions are the following:

(3) a) /naßaßwatania koßa omosaʧa no omokuŋu/ 'Did she/he unite them to be husband and wife?'
b) /tareteti kende pi/ 'Didn't she/he bring anything?'
c) /ßaʧire kwojia eŋombe/ 'Have they come to take the cow?'
d) /omonto oɣokora eŋaŋi nesese/ 'Is somebody wedding a dog?'

The above utterances were chosen for analysis because in their phonetic form, they can have either a declarative or an interrogative meaning. As this paper demonstrates, such differences in meaning can only be resolved through pitch modulation.

2.3 Data collection procedure

The participants were given the *yes-no* questions above printed on a piece of paper. Each participant, in a separate session, was asked to read the four questions aloud three times and as naturally as possible. Their speech was recorded in Praat[2] (Boersma and Weenink, 2012). The recordings were carried out in a quiet room at one of the researchers' home in a mono sound file at a sampling rate of 44100 Hz. The sound files created from the digitized waveforms were stored in the computer as WAV files.

[2]As Féry (2017: 30) suggests, "The most commonly used pitch tracker (algorithm generating pitch tracks) nowadays is Praat. […] Praat takes a digitized waveform as input that has been recorded or generated by a computer, or that comes from a different source, and it creates a Praat sound object or a sound file, which can be annotated with a TextGrid object".

2.4 Data analysis procedure

The data were analysed following the Tones and Break Index (ToBI) transcription system (Beckman et al., 2005: 9-54). Féry (2017: 119-120) points out that ToBI, as the basic tenet of the Autosegmental-Metrical (A-M) Theory, is a way of structuring utterances into a hierarchy of prosodic units. Intonation events are presented in six hierarchically ordered tiers. Two of these tiers are continuous phonetic records and the other four are symbol strings. The continuous phonetic record in this paper shows an audio recording of the *yes-no* questions with waveforms and fundamental frequency contours. The symbol strings used in this paper include the tones tiers, phonemic tiers, words tiers, and break index tiers. These are displayed in Figure 1 below.

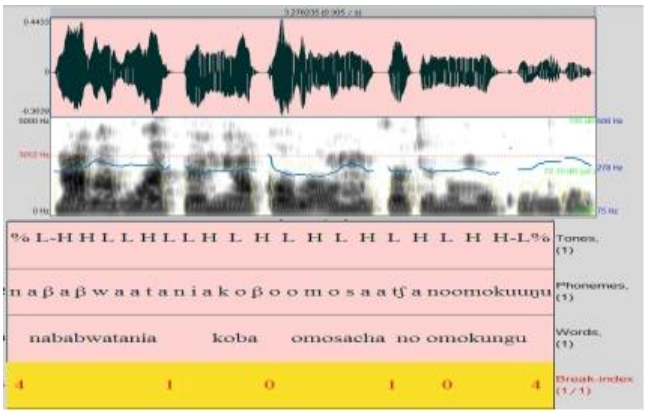

Figure 1: A ToBI transcription of an Ekegusii utterance

The upper panel in Figure 1 shows the utterance's waveforms and fundamental frequency while the lower panel indicates the tiers. The tones tier gives the intonation structure of an utterance as a sequence of high (H) and low (L) distinctive tonal units and the initial %L and final L% boundary tones. The phonemic tier shows the sequence of phonemes in the utterance while the words tier gives its orthographic transcription. For its part, the break index tier, which

uses four numeric values[3], shows the degree of juncture (strength) between two adjacent words. This is the metrical structure of the utterance in the A-M Theory.

In terms of statistical analysis, F0 means and standard deviations for each group of participants were computed using simple descriptive statistics. The SPSS software (Pallant, 2016: 69) was used to generate tables 1, 2, 3 and 4, which give a summary of the F0 values and variability between and among groups of participants in uttering the *yes-no* questions provided.

3 RESULTS AND DISCUSSION

In this section, the pitch tracks for the pronunciation of the *yes-no* questions by one male and one female participant from each of the four age groups is displayed. From the three repetitions of each speaker's pronunciation, only the one both the speaker and the researchers felt was the most natural is presented. Sub-section 3.1 presents results of the male speakers' pronunciation of the *yes-no* questions while Sub-section 3.2 presents those of the female participants. For its part, Sub-section 3.3 highlights the F0 variations among the different speakers.

3.1 Male speakers' pronunciation of *yes-no q*uestions in Ekegusii

Figure 2 displays the pitch track for the *yes-no* question /naβaβwatania koβa omosatʃa noomokuŋu/ *(*'Did she/he unite them to be husband and wife?') as uttered by a 75-year-old male.

[3]Beckman et al. (2005: 23) identify four break index values (0 to 4) in the break index tier. A numerical value of 0 shows a "very close inter-word juncture"; 1 represents a "ordinary phrase-internal word end", while 3 signals an "intermediate phrase end, with phrase accent", and 4 marks an "intonational phrase end, with boundary tone".

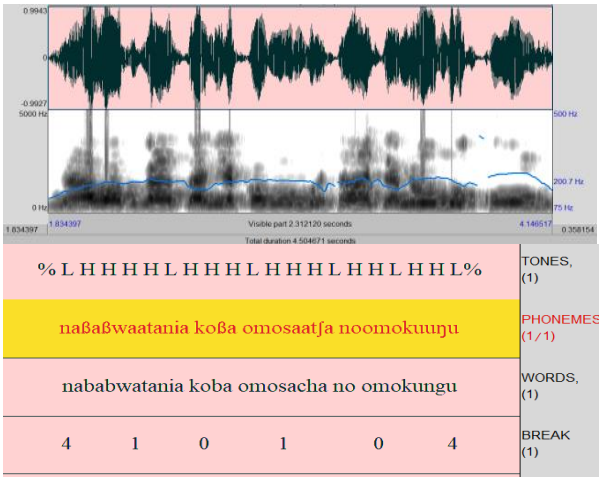

Figure 2: Audio waveform, F0 contour and ToBI label windows for the *yes-no* question /naßaßwatania koßa omosatʃa noomokuŋu/as uttered by a 75-year-old male.

The readings from the upper panel indicate that this speaker's vocal folds vibrated at an F0 of about 201Hz when pronouncing this utterance. From the tonal tier, we observed that there was a progressive raising of H-tones before other H-tones in such a way that the terminal H-tones are higher than the initial ones. Again, the speaker realised a final lowering towards the end of the utterance. This resulted in L% boundary tone for the utterance. The break index tier, at the bottom of the ToBI panel, shows that the metrical structure of the utterance was 410104. This means that the utterance was pronounced with an intonation phrase boundary at its beginning and termination as marked by the numeral 4; an ordinary phrase-internal juncture between the words /naßaßwatania/ 'she/he united them' and /koßa/ 'to be' and between /omosatʃa/ 'husband' and /*no*/'and' marked by the numeral 1. The 0-break index between /koßa/ 'to be' and /omosatʃa/'husband' shows a very close inter-word juncture between the words and sometimes merging of segments across the word boundaries as seen between /*no*/ 'and' and /omokuŋu/'wife' resulting in the word /noomokuŋu/'and woman'.

A middle-aged male participant produced the same utterance as shown in Figure 3.

Figure 3: Audio waveform, F0 contour and ToBI label windows for the utterance /naßaßwatania koßa omosatʃa noomokuŋu/ uttered by a 46-year-old male.

Figure 3 shows that the 46-year-old speaker pronounced the utterance at an F0 of about 128 Hz. Compared to the 75-year-old male speaker in Figure 1, we realise that this middle-aged speaker produced the utterance at a lower F0. A similar pattern of raising H-tones in the course of the utterance and the terminal L% boundary tone can be witnessed in the speaker's articulation too. It should be noted, however, that this speaker lacks the H-tone before the terminal boundary L% tone observed in the advanced-aged male participant in Figure 1. Instead, there is an L-tone before the L% boundary tone.

Figure 4 presents an 18-year-old male youth's pitch track for the same utterance.

Figure 4: Audio waveform, F0 contour and ToBI label windows for the utterance /naßaßwatania koßa omosatʃa noomokuŋu/ said by an 18-year-old male.

The 18-year-old male produced the utterance with a similar L% final boundary tone as the 75-year and 46-year-old male speakers in figures 1 and 2. This speaker also, just like the 46-year-old one, lacks a high tone before the final L% boundary tone witnessed in the 75-year-old one's articulation. This indicates that even within the same gender speakers vary in the production of the utterance. Again, this youth had a higher F0 (141 Hz) than the 46-year-old male.

As Figure 5 shows, a male child (11-years-old) articulated this utterance at the highest F0.

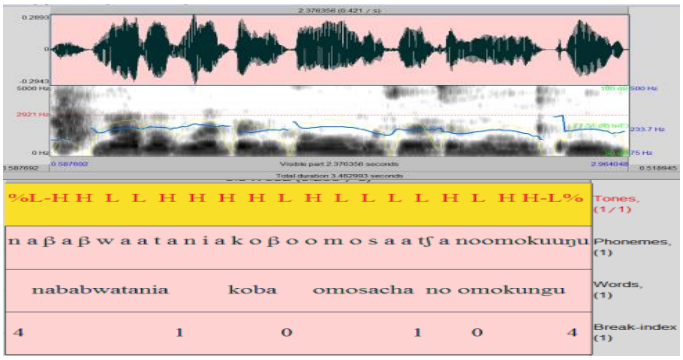

Figure 5: Audio waveform, F0 contour and ToBI label windows for the *yes-no* interrogative utterance /naßaßwatania koßa omosatʃanoomokuŋu/ said by an 11-year-old male.

The pitch track shows that the speaker pronounced the utterance with the vocal folds vibrating at 283 Hz. Again, all H-tones immediately after other H-tones are raised in the course of the utterance. This phonological process is called upstep and has been witnessed in all the male speakers' pronunciation. The greatest upstep can be seen in the second last syllable before the final fall resulting in H-L% boundary tone.

From the analysis of the male speakers' pronunciation, we conclude that a yes-no question in Ekegusii is terminated by a L% boundary tone. In addition, all H tones followed by H tones are raised in a process called upstep. Again, the child speaker pronounced the sentence at the highest F0, followed by the advanced-aged speaker and youth. The middle-aged speaker produced the sentence at the lowest F0. This shows that the F0 decreases from the children's group to the youth and the middle-aged groups before it once more increases in the advanced-aged group. This is compared with the female speakers' pronunciation in Sub-section 3.2.

3.2 Female speakers' pronunciation of the *yes-no* questions in Ekegusii

As already pointed out, male and female speakers have anatomic differences in their larynxes. These differences have a phonetic physical manifestation in their speech. In this sub-section, we analyse the female speakers' pronunciation of the same *yes-no* question used in the male speakers' speech in Section 3.1.

In Figure 6, we display the pitch track produced by a 61-year-old female speaker.

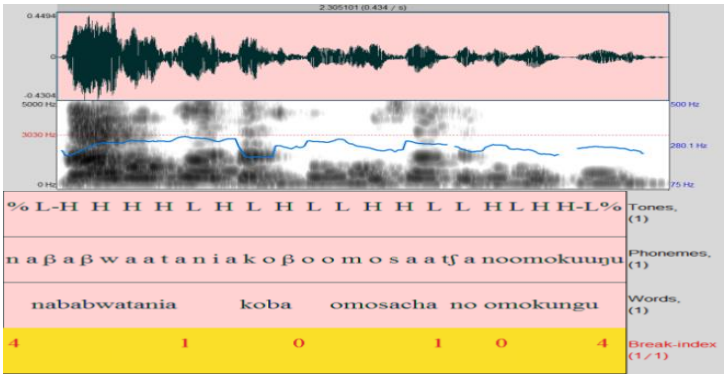

Figure 6: Audio waveform, F0 contour and ToBI transcription for the *yes-no* utterance /naßaßwatania koßa omosatʃa noomokuŋu/ by a 61-year-old female

The 61-year-old female articulated the utterance with the vocal folds vibrating at 280 Hz. Looking at the tones tier, we also note that the speaker's pronunciation of the sentence had a slight gradual declination in its course. This is however, interspersed with raising of H tones in a sequence of HH-tones. The final lowering before a H tone results in a H-L% boundary tone. The intonation tones produced in this participant's articulation were therefore similar to those of the advanced-aged male participant discussed in Sub-section 3.1. Differences however are noted in the F0 output; whereas the male speaker articulated the sentence at 201, the female one did it at 280 Hz.

A 48-year-old female speaker's production of the same utterance is given in Figure 7.

Figure 7: Audio waveform, F0 contour and ToBI transcription for the *yes-no* question /naßaßwatania koßa omosatʃa noomokuŋu/ by a 48-year-old female

The pitch track in Figure 7 shows that the 48-year-old female speaker produced the utterance with the vocal folds vibrating at 256 Hz. Again, sequences of HH have the second H realised at a higher level than the first. This phonological process has been termed upstep. At the end of the utterance we have the final lowering resulting in an L% final boundary tone. It is worth noting that the final L% boundary tone in the *yes-no* questions is phonetically higher than all the preceding L- tones in the same utterance for both the male and female participants analysed in this paper. This is because it is completely difficult to drop the final L-tone in a yes-no question due to the upstep witnessed in the earlier parts of the utterance.

A female youth's production of the same utterance is given in Figure 8.

Figure 8: Audio waveform, F0 contour and ToBI label windows for the yes-no question /naßaßwatania koßa omosatʃa noomokuŋu/ said by a 20-year-old female

As Figure 8 reveals, the 20-year-old female participant produced the utterance at a fundamental frequency of 260 Hz. Unlike the other female participants, this female youth had a %L utterance-initial boundary tone and a L% utterance-final boundary tone. Again, each successive H and L tone in the utterance is realized at a lower level in the course of the utterance. This pattern has been referred to as

declination. Declination in the participant's pronunciation is also a consequence of phonologised downstepping of the H-tones preceded by L-tones. This is contrary to the observations made for the other speakers who progressively raised H-tones in the course of the utterance except in the last syllable. This shows that the female youth displayed different intonation patterns. This was as expected because the greatest changes in voice pitch take place during puberty due to the rapid increase in the size of larynx.

Figure 9 presents a 9-year-old female child's pitch track for the same sentence.

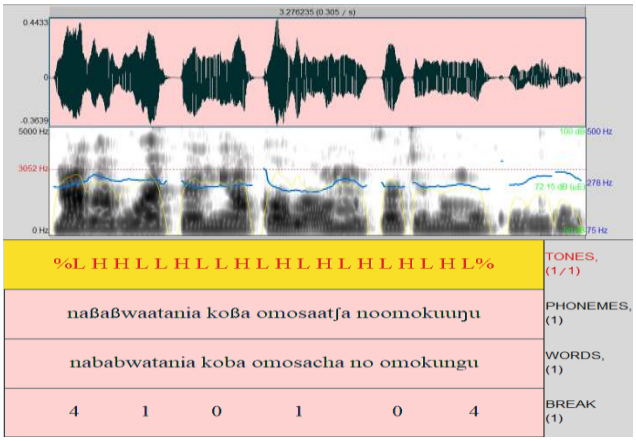

Figure 9: Audio waveform, F0 contour and ToBI label windows for the yes-no utterance /naßaßwatania koßa omosatʃa noomokuŋu/ said by a 9-year-old female

From Figure 9, we note that the female child pronounced the utterance with the vocal folds vibrating at 278 Hz. In addition, all H-tones before L-tones and high tones in the series HH are raised. Equally, the final lowering at the end of the utterance gives it L% terminal tone. We observed the same pattern in all the other male and female speakers whose pronunciations have been discussed in this sub-section.

The analysis of the female speech in this paper has shown similar intonation-related features as those recorded in male speech. Overall, a *yes-no* question utterance in Ekegusii is pronounced with a systematic raising of high tones when they are preceded by other high tones. Similar cases of upstep have also been recorded in Zulu (Katamba 1989: 207). The upstep recorded in Ekegusii yes-no

questions affects the high tones in the entire intonation phrase. Apart from upstep, Ekegusii *yes-no* questions also have a characteristic final low (L%) boundary tone. This has also been reported in Sesotho (Mixdorff et al., 2011), Cantonese (Ma et al., 2011) and Akan (Kugler, 2016), among other languages. Phonologically, this implies that Ekegusii *yes-no* questions do not end in a final high (H%) boundary tone which is a common feature in *yes-no* interrogatives in stress languages like English (Sadat-Tehrani, 2007: 70).

Though male and female speakers produced almost similar intonation features in *yes-no* questions, they varied in their F0 outputs. Data have shown that females speak at higher F0s than the males do across the four age groups. Consequently, in Section 3.3, we discuss the statistical significance of the age and gender differences in the F0 production noted above.

3.3 A statistical account of age and gender differences in the F0 production of *yes-no* questions

This sub-section presents and discusses the statistical significance of the intonation variations noted in the speakers' pronunciations. The discussion takes into account the F0s extracted from the 24 participants' pronunciations. Data are presented in the form of statistical tables generated using the SPSS. Table 1 presents a summary of the mean F0 values for the *yes-no* utterance /naβaβwatania koβa omosaʧa noomokuŋu/ 'Did she/he unite them as husband and wife?'

Table 1: F0 means and SDs for the utterance /naβaβwatania koβa omosaʧa noomokuŋu/

Participants	**F0**	**SD**
Female children	257.4000	23.83086
Male children	238.4667	42.05310
All the children	247.9333	32.28143
Female youth	227.5000	32.85925
Male youth	147.6333	16.87671
All the youth	187.5667	49.59261
Middle-aged female	236.5000	26.94290

Middle-aged male	115.5333	11.11590
All the middle-aged	176.0167	68.77262
Advanced-age female	245.6333	30.17156
Advanced-aged male	191.4000	27.91039
All the advanced-aged	218.5167	39.47280
Female average	241.7583	27.03474
Male average	173.2583	53.61637
The entire sample	207.5083	54.29990

Table 1 reveals that female participants in all the age groups pronounced the utterance at higher fundamental frequencies than the male ones did. The top line F0 range for Ekegusii females in this utterance was 257 Hz and the bottom line 228 Hz, while the top line for the males was 239 Hz and the bottom line 116 Hz. On average, the female participants produced the utterance at an F0 of 242 Hz while the male ones did it at 173 Hz. Although female participants seemed to have higher standard deviations in the individual groups' category except for the children, when we consider all the speakers' outputs, the standard deviation for the male participants is larger than that of the female participants. This shows that male speakers had great variability between the top line and bottom line F0s from the recorded mean while the small standard deviation for the female participants indicates that they had less variability from the mean in their F0s. Equally, children articulated the sentence at the highest F0 while the middle-aged speakers pronounced it at the lowest F0. Again, the middle-aged participants had the highest variation between the top line and bottom line F0 while the children had the lowest variation.

Table 2 gives a summary of the mean F0 production for the *yes-no* utterance /tareteti kende pi/ 'Didn't she/he bring anything?'

Table 2: Comparison of means and SDs for the utterance /tareteti kende pi/

Participants	F0	**SD**
Female children	253.4667	27.02227
Male children	243.6333	41.64425
All the children	248.5500	31.85572
Female youth	233.0667	38.62089
Male youth	150.3667	17.62735
All the youth	191.7167	52.65649
Middle-aged female	226.8667	37.39857
Middle-aged male	124.0000	11.43328
All the middle-aged	175.4333	61.53222
Advanced-aged female	267.1000	51.38511
Advanced-aged male	189.5333	10.39824
All the advanced-aged	228.3167	53.89246
Female average	245.1250	37.67744
Male average	176.8833	51.26909
The entire sample	211.0042	56.13290

Table 2 shows that there are gender and age variations in the pronunciation of the sentence. However, contrary to the pattern observed in Table 1 where the female children produced the highest F0, in Table 2, the advanced-aged females articulated the utterance at the highest F0. In both utterances, however the middle-aged males produced the lowest F0. The bottom line F0 for the females was about 227 Hz while the top line was 267 Hz. On the other hand, the highest F0 for the male speakers was 244 Hz while their lowest was 124 Hz. This shows that males had a higher disparity between the highest and lowest F0s than the females. This explains the high standard deviation in the male participants (51.3 Hz) and low SD in the female participants (37.7 Hz). In conclusion, female speakers pronounced the utterance at a higher F0, 245 Hz, than the male ones, 177 Hz.

Table 3 is a summary of the production of the *yes-no* question /ßatʃire kwojia eŋombe/ 'Have they come to take the cow?' by all the various groups of participants.

Table 3: The production of the *yes-no* question/ßaʧire kwojia eŋombe/ by all the groups of participants

Participants	F0	**SD**
Female children	251.6000	28.61660
Male children	233.9000	33.45549
All the children	242.7500	29.48320
Female youth	221.3333	33.40604
Male youth	149.7667	18.71265
All the youth	185.5500	46.07588
Middle-aged female	210.4667	12.61441
Middle-aged male	130.2333	6.04511
All the middle-aged	170.3500	44.82726
Advanced-aged female	255.3333	32.97064
Advanced-aged male	197.9667	26.21266
All the advanced-aged	226.6500	41.19402
Female average	234.6833	31.32515
Male average	177.9667	46.89728
The entire sample	206.3250	48.58319

From Table 3 we see that the female speakers pronounced this *yes-no* question with their vocal cords vibrating at an average F0 of 234.7 Hz. The males had an F0 range of about 178.0 Hz. In addition, similar to 3b, the advanced-aged females pronounced utterance 3c at the highest F0, 255Hz, while the middle-aged males at the lowest F0, 130 Hz. The female pitch range bottom line was 211 Hz and the top line was 255 Hz while the male F0 bottom line was 130 and the top line 234 Hz. The observations above reveal once more that men had a large variation than the women with regard to the high and low F0 ranges (SD=46.9 Hz and 31.3 Hz for the male and female participants respectively). In addition, middle-aged participants had the highest variation between the top line and bottom line F0 while the children had the least variation as shown in the SD column.

The pronunciation of the utterance /omonto oɣokora eɲaŋi nesese/ 'Is somebody wedding a dog?' is also summarised in Table 4.

Table 4: The production of the *yes-no* question utterance /omonto oɣokora eɲaŋi nesese/ by all the groups of participants

Participants	F0	**SD**
Female children	262.8667	27.35184
Male children	250.8333	40.51127
All the children	256.8500	31.60941
Female youth	242.0667	50.19973
Male youth	149.9667	7.58705
All the youth	196.0167	59.79761
Middle-aged female	229.9667	9.61058
Middle-aged male	132.5333	2.19621
All the middle-aged	181.2500	53.72942
Advanced-aged female	274.1333	69.15174
Advanced-aged male	211.7000	31.72964
All the advanced-aged	242.9167	59.03278
Female average	252.2583	42.49112
Male average	186.2583	54.34122
The entire sample	219.2583	58.41348

Table 4 indicates that participants varied in the articulation of this utterance. Similar to early observations about the other utterances, female speakers produced the utterance at higher F0s than the male ones. The advanced-aged females again produced the utterance at the highest pitch register, 274 Hz. The young and the middle-aged male speakers had a small standard deviation while the advanced-aged female speakers had a large standard deviation. The high and low F0s noted in the articulation of the yes-no questions have a communicative function in language. For example, Gussenhoven (2004: 82) suggests that feminine and masculine values are associated with submissiveness and dominance and that high pitch shows friendliness, politeness and vulnerability while low pitch signals confidence, aggressiveness and scathing.

From Tables 1-4 we conclude that male and female participants of different age groups showed variation in their top line, bottom line and average F0s in *yes-*

no questions in Ekegusii. There were also intra-speaker variations with the middle-aged participants showing the greatest intra-variation in their F0 realisation in the four utterances.

4 CONCLUSION

In conclusion, this paper has revealed that male and female participants of different ages had varied nominal F0 ranges that their voice covered in articulating *yes-no* questions in Ekegusii. On average, the male speakers' pitch range modulation was realised at an F0 bottom line of 126 Hz and top line of 242 Hz while the female speakers' F0 bottom line was 226 Hz and top line 260 Hz. Moreover, although female speakers realised higher mean F0s than the male ones in articulating the *yes-no* questions, they showed less variability in F0 production.

In addition, results have shown that the advanced-aged female participants had an F0 nominal range of 260 Hz, female children 256 Hz, male children 242 Hz, the female youth 231 Hz, the middle-aged females 226 Hz, the advanced-aged males 196 Hz, the male youth 150 Hz and the middle-aged males 126 Hz. This shows that the advanced-aged female group of participants and the male children's group produced the highest F0s while the middle-aged groups (namely the female and male) produced the lowest F0. The greatest variation in F0 production occurred among the youth and the lowest one among the children.

Another finding that emerged from this study is that *yes-no* questions in Ekegusii are pronounced with a characteristic upstep of H-tones when preceded by other H-tones and with a low (L%) boundary tone. A low (L%) boundary tone was also recorded in declarative utterances in Ekegusii (Komenda et al., 2020: 117-135). This therefore means that a *yes-no* question in Ekegusii can only be distinguished from a declarative utterance with the same phonetic structure through a difference in fundamental frequency. A comparison in F0 output between declarative utterances discussed in Komenda et al. (2020: 117-135) and their *yes-no* counterparts in this paper shows that utterance (3a) had an F0 of 184.6 Hz as a declarative, but an F0 of 207.5 Hz as a *yes-no* question. Utterance (3b) had 186.4 Hz as a declarative, and 211 Hz as a yes-no question. Utterance

(3c) had 181.7 Hz as declarative, but 206.5 Hz as a yes-no question. Utterance (3d) had 185.5 Hz as a declarative, but 219 Hz as a yes-no question. Therefore, a *yes-no* question in Ekegusii is uttered at an average top line F0 of 219 Hz and a bottom line F0 of 206 Hz, while its declarative counterpart is uttered at a top line F0 of 186 Hz and a bottom line F0 of 182 Hz.

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