Characterization of Interrogative Sentences in Filipino Speech

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ABSTRACT
This paper presents an attempt to experimentally find the general characteristics of interrogatives in Filipino speech in terms of pitch, duration and intensity patterns. The speech corpus developed in this study consisted of recordings of 275 interrogative sentences of different types uttered by 88 individuals. Analysis showed that out of the 5 different types of interrogatives considered, only the yes-no type exhibits a rising intonation towards the end of the sentence. Another important observation from the experiments was the existence of duration lengthening pattern on either the penultimate or the final syllable of the sentence. Although intensity patterns do not show a strongly generalizable result, a minor finding was that the interrogative particle ‘ba’ often receives the highest intensity throughout the construction.

1. INTRODUCTION
The characterization of interrogatives in a certain language is significant in that it can find many uses in processing continuous human speech. For instance, the distinguishing characteristics of interrogatives may improve how machines interpret a naturally spoken speech. Another potential use of the characterization is for parametric or semi-parametric prosody modification in Text-To-Speech (TTS) systems. For example, a previous work [1] presented a non-parametric method for prosody modification through embedding macroprosody features extracted from prerecorded utterances of selected Filipino sentences.

There have been studies regarding characterization of interrogatives in other languages such as English, Spanish [2][3], and Arabic [4]. However, there are only a relatively few experimental studies regarding interrogatives in Filipino, and most of them limited their analysis on intonation patterns only. With both the Spanish and the Filipino language being syllable-timed, two similar studies [2][3] in Spanish served as important references and basis for the experiments conducted here. The study by Face [3] conducted perception experiments using distinctive intonation patterns for declarative and interrogative sentences in Spanish. On the other hand, the study by Romera, et. al. [2] reveals finding some dominant syllable lengthening pattern towards the last syllable in Spanish interrogatives. The focus of this work is on the characterization of interrogatives in Filipino language, not only in terms of intonation patterns, but in terms of syllable duration and intensity patterns as well.

1.1 Interrogatives in Filipino
In the past, Filipino (based on Tagalog language) interrogatives tend to be analyzed following the English intonation pattern as a template. It is commonly observed that yes-no questions tend to be pronounced with rising intonation in English while Wh-questions may either be rising or falling.

Schachter and Otanes [6] divided Filipino questions into five classes, according to the type of answers they normally elicit. The five classes are: (1) yes-no questions; (2) alternative questions; (3) confirmation questions; (4) information questions and; (5) please-repeat questions.

Like English, Filipino yes-no questions are marked by a rising intonation pattern, but there is no special interrogative word order [6]. Filipino includes the enclitic particle ba to mark yes-no questions. However, provided that the appropriate intonation is used, the question is understood as such whether or not it includes ba. (See example questions in Fig.1.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mabait si Pilar.</td>
<td>Mabait (ba) si Pilar?</td>
</tr>
<tr>
<td>(Pilar is kind.)</td>
<td>(Is Pilar kind?)</td>
</tr>
<tr>
<td>Filipino (ba) si Bob, o</td>
<td>Filipino (ba) si Bob, o</td>
</tr>
<tr>
<td>Amerikano?</td>
<td>Amerikano?</td>
</tr>
<tr>
<td>(Is Bob a Filipino, or an</td>
<td>(Is Bob a Filipino, or an</td>
</tr>
<tr>
<td>American?)</td>
<td>American?)</td>
</tr>
</tbody>
</table>

Fig.1. Examples of Filipino sentences.

An alternative-type question is a question to which the expected answer is one of two or more alternatives given. Most alternative questions are analyzable into two parts, the first of which is a normal yes-no (including normal interrogative intonation) and the second of which begins with an alternative conjunction ‘o’ and has a statement intonation. (See second question in Fig.1.)

A confirmation question is one to which the expected answer is assent to a proposition made by the questioner. Unlike in English, confirmation questions (also called tag questions) do not vary in form according to whether the proposition to be confirmed is affirmative or negative. Filipino, however, has a number of different formulas that are used in confirmation questions. These formulas are: ano, hindi ba (or di ba), etc.
Information question (also called Wh-question) is a question to which the expected answer is information that falls within a semantic and structural category indicated by the questioner. In Filipino, as in English, the category, within which the expected information falls, is indicated by the use of interrogative words, e.g. sino ‘who’, saan ‘where’, ano ‘what’, kailan ‘when’, bakit ‘why’. Information questions have their own characteristic intonation patterns which differ from yes-no questions. A recent study on Filipino interrogatives [5] has affirmed that there is a rising intonation in the yes-no question, falling intonation in tag questions, and three intonation patterns in Wh-questions (falling as most dominant, rising and rising-falling).

This paper examines the five different types of interrogatives, namely: yes-no, alternative, confirmation, information, and plural information. The three important speech parameters, namely pitch, duration and intensity, throughout the syllables in each sentence in the corpus were measured and analyzed in order to come up with a general characterization of interrogatives.

2. METHODOLOGY

The authors of this study generally aim to experimentally find and quantize important patterns and/or characteristics of interrogative sentences in Filipino speech. With this objective, a speech corpus of different interrogative sentences uttered by 88 participants was developed for the said purpose. The recorded sentences were analyzed for feature patterns in pitch, duration and intensity.

2.1 Design of Questions

This study looked at the five different types of interrogatives uttered in a natural and neutral manner. Following Schacter and Otanes [6] classification of interrogatives, the five sentences were constructed as follows:

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutugtog ba si Francisco? (Will Francisco play?)</td>
<td>yes-no</td>
</tr>
<tr>
<td>Tutugtog ba si Francisco, o kakanta? (Will Francisco play, or sing?)</td>
<td>alternative</td>
</tr>
<tr>
<td>Tutugtog si Francisco, ‘di ba? (Francisco will play, won’t he?)</td>
<td>confirmation</td>
</tr>
<tr>
<td>Bakit tutugtog si Francisco? (Why will Francisco play?)</td>
<td>information</td>
</tr>
<tr>
<td>Sinu-sino ang sasama kay Francisco? (Who are coming with Francisco?)</td>
<td>plural information</td>
</tr>
</tbody>
</table>

Notice that the sentences were designed in such a way that the syllable boundaries may easily be identified for the purposes of analysis (of syllable durations, for instance). That is, the words in the sentences were chosen such that in most cases, vowels and fricatives or stops alternate in sequence.

2.2 Speech Corpus

The speech corpus developed in this study involved the recordings of utterances of the five different types of interrogative sentences produced by 88 participants (29 of which are females and 59 are males). Each participant is a Filipino native speaker and has been a speaker of the language for about 16 years. Moreover, majority of the participants are college students with ages ranging from 19-22 years.

The participants were initially given the five different questions for them to read first. Then they were asked to utter the sentences as naturally as they possibly could. That is, uttering the sentences as if they were conversing with another person.

Computers were used for recording the utterances of the interrogatives. Some recordings were lightly processed (for reduction of random noise, humming noise, clicks and other background noise, and for volume adjustment) using a sound editing software program.

Overall, the speech corpus contains a total of 275 recorded sentences, all of which were analyzed for their feature patterns (pitch, duration and intensity per syllable).

2.3 Speech Feature Measurements and Analysis

After light preprocessing of the recordings, the average pitch, duration and intensity of each syllable in the recorded utterances were measured using a speech processing software program. The measurement method is graphically illustrated in Fig.2. Note from the figure that the highlighted syllable exhibits a slightly varying pitch contour and intensity contour throughout the syllable. We considered measuring only the average value of the pitch and the intensity.

In determining the most dominant pitch pattern, proper scaling before the actual averaging process was done. This was necessary because different people have different speaking pitch range. This fact is graphically illustrated in Fig.3. The scaling factor is simply calculated as the ratio of two different local (per sentence) pitch averages.

Similarly, the syllable duration patterns throughout the sentences were properly scaled first before the actual averaging across all speakers was done. This was necessary to compensate for fast or slow speakers. Moreover, scaling was also done before averaging the intensity patterns across the different speakers. This was again necessary to compensate for the different volume levels found in the speech corpus.
3. RESULTS AND DISCUSSION

The first subsection presents the results regarding the dominant pitch patterns among various speakers involved in the speech corpus. The second and third subsections present the results for syllable duration patterns and the results for syllable intensity patterns, respectively.

3.1 Dominant Pitch Patterns

From the syllable pitch measurements in the 275 sentences in the corpus, the average or dominant pattern was calculated for each type of question. The results for the five different types of interrogative sentences are graphically presented in Fig.4, where the x-axes show the syllables while the y-axes show the average pitch in Hertz.

It can be seen from the results that among the five different types of interrogatives, only the yes-no type of question exhibits a rising intonation towards the last syllable of the sentence (as seen in the first plot of Fig.4), with the penultimate syllable receiving the lowest pitch in the construction. The other four types of questions (alternative, confirmation, information and plural information) all exhibit a falling intonation towards the end of the sentence.

As seen in the second and third plots of Fig.4, the first clause of the alternative-type and the confirmation-type sentences seem to contain almost the same intonation pattern as that of the yes-no type of question. For instance, if we remove the alternative clause in the alternative-type question, we may perceive the remaining clause as very similar to the yes-no type of question.

The information- and the plural information-type questions both exhibit a generally decreasing intonation (as seen in the last two plots of Fig.4). Towards the end of these type of questions, the penultimate syllable exhibits a gradual rise in intonation followed by a significant drop towards the last syllable.

Additional experiments done by modifying the proper noun ‘Francisco’, a three-syllable noun, into ‘Francis’, a two-syllable noun, showed that the intonation patterns for the five different interrogative sentences generally retain their original characteristics. Two of these results, namely for the yes-no and the confirmation questions, are shown in Fig.5. Note that both the first plots of Fig.4 and Fig.5 show a rising intonation towards the end of the sentence, while both the second plot of Fig.5 and the third plot of Fig.4 show a rising and then falling intonation towards the end of the sentence.

Finally, it is worth noting that although the last few syllables in the yes-no type of question generally exhibit a rising intonation towards the end of the sentence, the last syllable also generally exhibits the highest pitch variance. This can be seen from Fig.6, which shows the standard deviation in pitch for each syllable in the yes-no type of question. The said variation in pitch rise may be due to several factors such as speaker’s certainty, feelings, etc.

3.2 Dominant Syllable Duration Patterns

Similarly, from the syllable duration measurements, the average patterns were determined. The results are shown in Fig.7, where the x-axes show the syllables while the y-axes show the average syllable duration in milliseconds.

![Fig.3. Illustration of two different speaker’s pitch range](image-url)
From the results, we may note that the yes-no, information and plural information type of questions exhibit syllable lengthening in the penultimate syllable of the sentence (as seen in the first, fourth and fifth plots of Fig.7). For the alternative-type, the longest syllable is the penultimate syllable of the first clause (as seen in the second plot of Fig.7). Although the confirmation-type have a relatively lengthened penultimate syllable in its first clause, it turned out the the longest syllable was the interrogative particle ‘ba’ (as seen in the third plot of Fig.7), which happens to be the final syllable in the whole sentence.

For the additional experiments (where ‘Francisco’ was changed to ‘Francis’), the longest syllable in most cases turned out to be the final syllable ‘cis’ in ‘Francis’. Fig.8 illustrates two of these results. It may be generalized that although the syllable lengthening towards the end of the sentence can commonly be observed in all the types of interrogatives, the longest syllable may be any of the final few syllables in the sentence. Some factors that may affect the variation are the number of syllables and the position of the stressed syllable in the last word of the sentence.

Finally, it is also worth noting that the duration of either the final syllable of the sentence, or the interrogative particle ‘ba’, usually exhibits the largest variance in terms of duration. This can be seen from Fig.9, which shows the standard deviations of the syllable durations for the yes-no, confirmation and plural information type of questions. This implies that although it can commonly be observed, the syllable lengthening process is done at a widely varying degrees by different speakers.

3.3 Dominant Syllable Intensity Patterns

From the syllable intensity measurements, the average patterns were also determined. Three of the results are shown in Fig.10.

From the results, the only observable intensity pattern is that the interrogative particle ‘ba’ in the yes-no and the alternative-type questions seem to receive the highest intensity. This may be due to the fact that ‘ba’ distinctively marks the sentence as being interrogative, so that emphasis, in terms of intensity, is given to this syllable.
Fig. 8. Average syllable duration patterns for modified yes-no and information questions. (i.e., changing the noun “Francisco” into “Francis”).

Fig. 9. Standard deviations of syllable durations for yes-no, confirmation and plural information type of questions, respectively.

4. SUMMARY AND CONCLUSION

In this study, the five different types of interrogative sentences in Filipino, namely, yes-no, alternative, confirmation, information and plural information, were characterized in terms of syllable pitch, duration and intensity patterns. A speech corpus containing 275 interrogative sentences in Filipino, which were uttered by 88 individuals, was developed and used for analyzing the dominant patterns existing in the said interrogatives.

The first important result obtained from the experiments was the affirmation that dominantly, only the yes-no type of question exhibits a rising intonation towards the last syllable of the sentence. It can also be observed in the yes-no type of question that the penultimate syllable receives the lowest pitch in the whole sentence construction. All the other four types of questions exhibit a falling intonation towards the end of the sentence. Moreover, the first clause of the alternative-type and the confirmation-type of sentences seem to contain almost the same intonation pattern as that of the yes-no type of question. In the information- and the plural information-type questions, the penultimate syllable exhibits a gradual rise in intonation followed by a significant drop towards the last syllable.

Another important result obtained from the experiments is the existence of syllable lengthening towards the end of the interrogative sentences. But unlike in the Spanish language, where the lengthening is observed only on the last syllable of the sentence [2], syllable lengthening in Filipino interrogatives may either be at the penultimate syllable, or the last syllable in the sentence.

Aside from the observation that the interrogative particle ‘ba’ in the yes-no and the alternative-type questions seem to receive the highest intensity, there are no other generalizable intensity patterns that can be seen in Filipino interrogatives.

The study presented in this paper made use of the same question (for each category or type of interrogative sentence) for all the participants to utter. Future work may pursue a more complex analysis on Filipino interrogative sentences by using different questions for each category. The work presented here may also be extended for prosody modification applications in Filipino speech, such as in [1], and for doing perception experiments, such as in [3], in order to further characterize the Filipino interrogative sentences.
5. REFERENCES


