

Using *Praat* to Teach Intonation to ESL Students

Hang Thu Le & Jennifer Brook

Abstract

This paper explores whether using *Praat*, computer software for phonetic analysis, can rapidly improve pronunciation skills for ESL students. We report on a pilot study in which six ESL students used *Praat* for phonetic stress pattern analyses and sound manipulation, particularly with *yes/no* and *wh*-questions. The results showed that *Praat* could enable students to refine their pronunciation. By having instant visual feedback, students were able to actually observe the errors that they might not otherwise notice through listening alone. This pilot study also demonstrates that the training from *Praat* transferred to sound production as the students were able to produce these question forms more clearly and naturally in a subsequent dialog reading task. Through the results of this pilot study, this paper shows how ESL/EFL teachers and students can benefit greatly from this free and readily available open-source educational software.

Introduction

The challenge of non-native speakers in learning English pronunciation is that it can be difficult to hear the difference between the target pronunciation and their own. To this end, *Praat*, a free, easy to use, and readily available open-source piece of software, can assist English language learners by generating a visual representation of the students' utterance. *Praat* accomplishes this by recording sound samples and drawing, among other things, the visual pitch contour of the utterances. As such, *Praat* is a useful tool that can be used to teach aspects of suprasegmental pronunciation, such as intonation, as well as segmentals, such as vowel sounds. Teachers can also use *Praat* to evaluate English learners' pronunciation, measure improvement over time, and to pinpoint each individual student's problems efficiently. With this in mind, this paper aims to review how *Praat* can assist in teaching and learning English pronunciation, and then presents the results of a pilot study that was specifically designed to explore how *Praat* can enable students to improve their intonation.

Computer Assisted Pronunciation Learning

Computer-assisted pronunciation (CAP) is the use of digitized speech for improving language pronunciation (Rostron & Kinsell, 1995, as cited in AbuSeileek, 2009). Raux and

Kawahara (2002) reported that recent computer-assisted pronunciation learning focuses on two major areas: evaluation of the learner's current pronunciation and instruction of the different aspects of pronunciation such as stress and intonation, both of which can be enhanced with the use of *Praat* as an instructional tool.

Computer-aided pronunciation instruction offers many advantages that are not usually available in conventional contexts. For example, Neri, Cucchiarini, and Strik (2002) pointed out that digitized pronunciation software allows students to individually access unlimited and realistic L2 input through different channels and provides individualized feedback automatically and instantaneously. There are a variety of interactive software packages for providing English learners with the opportunity to perceive and practice pronunciation. Some software programs focus on the articulation of sounds, while other computer software programs can also offer learners a chance to listen to prerecorded materials. Digitized pronunciation software packages, such as software for pronouncing dictionary definitions, provide high-quality sound recordings and video clips of speakers, which gives the learner the opportunity to look at articulatory movements that are used in producing sounds (LaRocca, 1994). In contrast, *Praat* focuses on acoustic phonetic analysis, rather than providing the learner with pre-recorded examples of native speakers in



order to emulate. *Praat* can be used to assist learners' pronunciation by allowing them to analyze the visual patterns of their own speech in order to distinguish how it differs from the target pronunciation. At the same time, the teacher can also use the program to analyze their students' speech patterns for evaluation or diagnostic purposes. Additionally, *Praat* can analyze the speech of anyone who has access to a computer and a microphone. *Praat* accomplishes this by graphing the acoustic aspects of speech sounds through visual representation.

The use of *Praat* to provide feedback in pronunciation classes promotes autonomous learning in an area of language teaching that has traditionally had to rely on native speakers' judgments for evaluation (Wilson, 2008). These native speaker judgments often require the teacher to verbally explain to the student whether his or her pronunciation is meeting the desired target or not. This type of explanation can be limited, especially when unaccompanied by visual or other cues. When language learners use *Praat*, they can compare their voices to a pre-recorded model made by a native speaker. For example, Shirer (as cited in AbuSeileek, 2007) confirmed in his study that it is possible to use computers, speech technology, and linguistic knowledge to enable learners to hear the voice of an English native speaker while also being able to break down how the utterance is produced. Students are able to compare their performance to the native English speaker model, sound by sound, while also tracking their progress over time.

However, there may be some limitations for the use of *Praat* for some teachers. For example, Setter and Jenkins (2005), in their state-of-the-art review of pronunciation teaching, pointed out that being able to successfully interpret formant plots¹ on a *Praat* diagram that illustrate the resonance of a person's voice requires "a sophisticated level of understanding" on the part of both teacher and learner (as cited in Wilson, 2008). Even without using such advanced features, teachers or students who are not familiar with computers can have difficulty operating the software at first.

With this said, for the most part, *Praat* can be used in ways that do not require sophisticated phonetic training. For example, with some minimal guidance from the teacher, the pitch display from *Praat* is straightforward enough for students to interpret intonation. The representation of the pitch display is simple: *Praat* draws an intonation contour that matches the pitch variation in the provided speech sample. In play-back mode, students can hear the sounds as they watch the cursor move along the pitch contour. Students can also see the duration of speech sounds and identify which words are stressed or have higher pitches and intensity, while also measuring the overall intonation curve of an utterance.

Research Question

Inspired by previous studies on the use of computer technology for the teaching of pronunciation and by the availability of *Praat*, a small-scaled study was carried out in order to find out whether ESL learners could improve their pronunciation by using *Praat*. The research question posed in this study was: to which extent, if any, could the use of *Praat* improve the learners' intonation as they practiced *yes/no* and *wh*-questions?

Methods

Subjects

Six students, who were studying English at a language center in Hawaii, participated in this pilot study. They were five Koreans and one Japanese. The students' English level was low intermediate. The students all had strong motivation to achieve success in an academic environment. At the time of the study, one of the authors was the student teacher for the class.

This particular language center had six levels in their curriculum with five "communicative theme-based" classes at each level: speaking and listening, pronunciation, vocabulary, grammar, and reading and writing. All of the six students had planned to continue their studies at the English language school before entering a degree program at an American university, or working in a scholarly

setting. Table 1 contains the relevant back-

ground information of the six participants.

Table 1
Summary of Participants' Backgrounds

Participants	Age	Gender	Years of English study in their countries	Length of residence in the U.S. (in months)	Proficiency level
Student #1	22	Female	7	2	(Low-intermediate)
Student #2	19	Female	9	5	(Low-intermediate)
Student #3	33	Female	8	17	(Low-intermediate)
Student #4	19	Female	9	9	(Low-intermediate)
Student #5	21	Male	14	14	(Low-intermediate)
Student #6	18	Female	11	6	(Low-intermediate)

The student teacher/researcher observed that the students had no serious problems with reading and writing at this level; however, most of the students still experienced some difficulty with English pronunciation and intonation. Their native languages, Korean and Japanese, had a markedly different intonation in comparison to English.

Instruments

The instrument used in this pilot study was a set of tests that were created and prepared by the student teacher/researcher. Three tests, a pre-test (Appendix A), post-test #1 (Appendix B), and post-test #2 (Appendix C) were developed in order to measure the students' pronunciation and to also evaluate if they showed any improvement in their intonation after practicing with *Praat* software. The tests that were created consisted of *yes/no* and *wh*-questions. Each test had two tasks. In task 1, students were asked to read three *yes/no* questions and then three *wh*-questions. In task 2, the students read a provided dialogue that contained the two target types of questions with a partner.

The students were encouraged to read the questions and the dialogues provided in the tests aloud and to try to pronounce them as clearly and naturally as possible. However, the students were not explicitly told that they were being evaluated on the intonation of their pronunciation. The purpose of this was

to have the students speak as naturally as possible in order to increase the reliability of the study.

Data Collection

The students were asked to participate in ten sessions of forty-five minutes each to practice refining their pronunciation using *Praat*. In the first session, the students were asked to take a pre-test before the researcher introduced the software to the students. During the introduction session, the researcher led a training session on how to (1) record their voices; (2) read the visual display of their speech; (3) compare their speech to native speakers' in the *Praat* window; and (4) refine their own pronunciation through the audio/visual contrast that they perceived with the help of the program, based on their interpretation of the visual displays. It should be noted that the program itself does not interpret the students' intonation patterns on its own and does not provide specific feedback; rather, the users, in this case the students and the teacher, must interpret the output of the visual graphs in order to determine if they have produced the utterances in a target-like manner. Following four practice sessions, the researcher then asked the students to complete Post-test #1. After the tenth session, the students took Post-test #2. There were two weeks between Post-test #1 and Post-test #2. The results of Post-tests #1 and #2 were then compared to

both the pre-test results and the native speaker model in order to evaluate how much the students had improved toward the target

pronunciation after practicing with *Praat*. A summary of the training and testing sessions is provided in Table 2.

Table 2

Summary of Training and Test Sessions

Week	Session	Activity
1	1	Software introduction, Training session, & Pre-test
	2	Exercise
	3	Exercise
2	4	Exercise
	5	Exercise
	6	Post-test #1
3	7	Exercise
	8	Exercise
	9	Exercise
4	10	Exercise
	11	Exercise
	12	Post-test #2

As the students recorded their utterances using the *Praat* program, their sound recordings were saved as wave files (.wav) for later playback and analysis by both the students themselves as well as the student teacher/researcher.

Analytical Procedure

The wave files of the students' recorded sound production in both the pre-tests and the post-tests were viewed in *Praat*. The analysis focuses on the pitch of the students' utterances. The visual display of the pitch contour of the students' speech was examined and compared to the native speaker's pitch contours. In order to examine each student's improvement or lack thereof, the pitch contour for each utterance was considered

holistically. Individual scores were not given based on the differences between each of the pitch contours and the native speaker's sample; rather, measurements of any improvements were made subjectively by examining the students' pitch contours in their own right. Only the student teacher/researcher performed the evaluation.

Results

After viewing the visual pitch contours of the questions produced by the students, it was concluded that most of their pronunciation had improved. While some students showed moderate or no improvement, most of them improved their pronunciation significantly. Below, the students' results are presented in

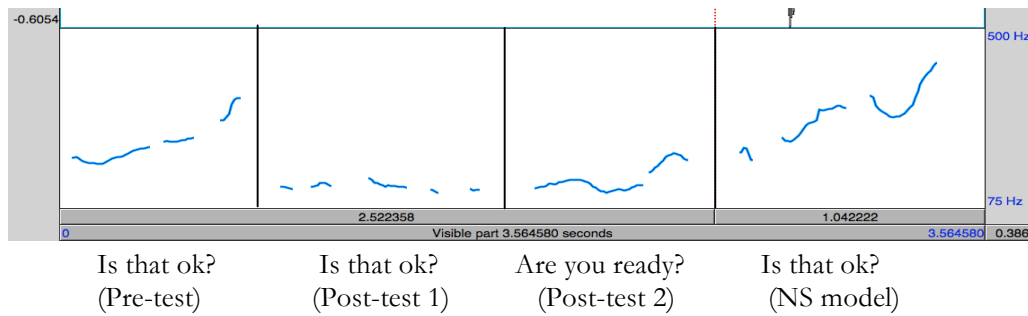
two categories: no or moderate improvement and substantial improvement.

No or Moderate Improvement

In the evaluation of the students' Praat graphs it was found that only one of the students, as seen in Figure 1 below, showed no

improvement in *yes/no* question intonation. This outlier student actually performed better on the pretest than in either of the post tests after practicing with Praat, which was an exception among the students who participated in the study.

Figure 1. Visual display of the pitch contour of *yes/no* questions that were produced by Student #4 compared to the native speaker's model

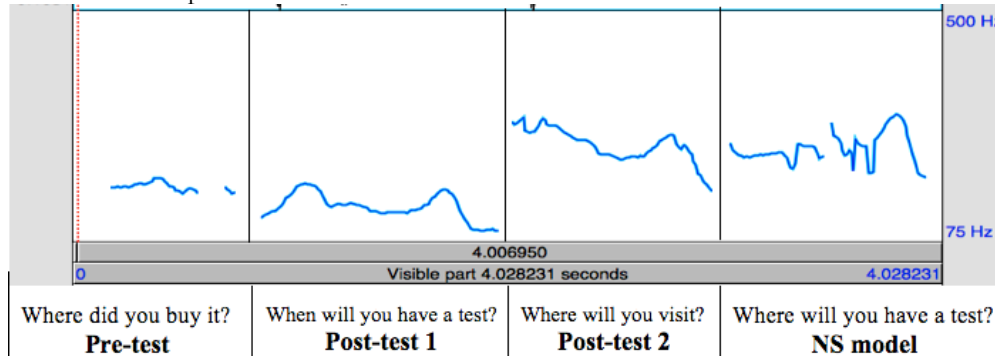


A number of reasons may be presented to explain why this particular student was the sole participant to show no improvement in intonation. One possible explanation could be that the student had performed well during the pre-test and then was sick, or was somehow distracted on the dates of the post-tests. Unfortunately, we do not have any data to elucidate on these questions.

Interestingly, this same student demonstrated moderate improvement when her

utterances of *wh*-questions were analyzed. As demonstrated in Figure 2 below, this student showed gradual improvement by the completion of the study. In the Pre-test and Post-test 1, the student demonstrated a pitch contour with a high initial frequency; however, in Post-test 2 the student showed moderate improvement toward the native-speaker sample.

Figure 2. Visual display of the pitch contour of *wh*-questions that were produced by Student #4 compared to the native speaker's model



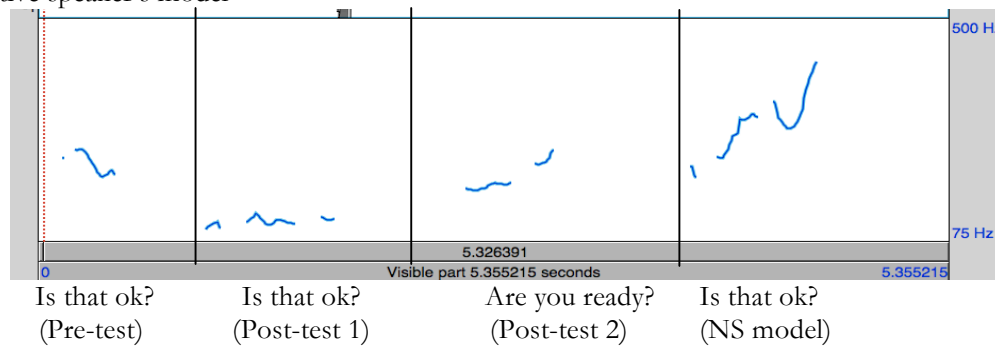
Of the students who had moderate improvement, the pitch contour showed

improvement in some parts of the sentences in the post-tests, but did not demonstrate the

production of a sentence with “native-like” intonation. Figure 3 below demonstrated how Student #6 performed on the *yes/no* questions. In the pre-test, the student used falling instead of rising intonation, in Post-test #1, she was no longer using falling intonation but was not

yet using rising intonation; in Post-test #2 she demonstrated rising intonation although it does not rise as much as the target native-speaker model.

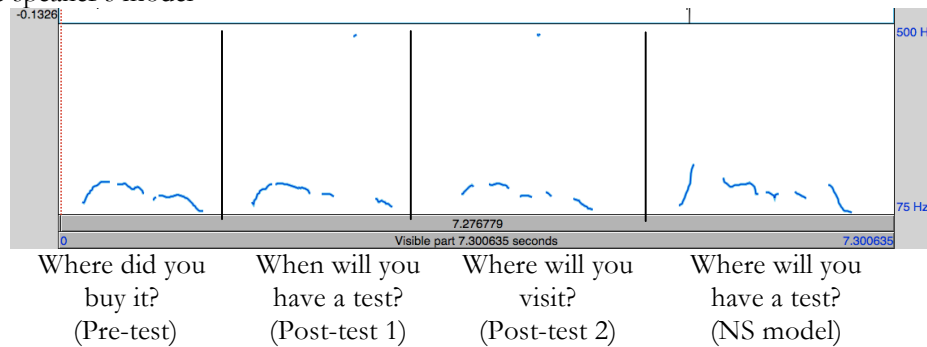
Figure 3. Visual display of the pitch contour of *yes/no* question produced by Student #6 compared to the native speaker’s model



Regarding the *wh*-question utterances by the same student, she made no improvement between the Pre-test and Post-test 1; however, she demonstrated a moderate rising and falling intonation pattern in the Post-test #2, which more closely echoed the native speaker

model. With this said, this student was not determined to have demonstrated significant improvement as she did not achieve the final rising-falling intonation in the final syllable of the question.

Figure 4. Visual display of the pitch contour of *wh*-questions produced by Student #6 compared to the native speaker’s model



Substantial Improvement

In Post-test #2, several students achieved pronunciation of English intonation that was native-like. There were four students in the group who demonstrated substantial improvement in their pronunciation after using

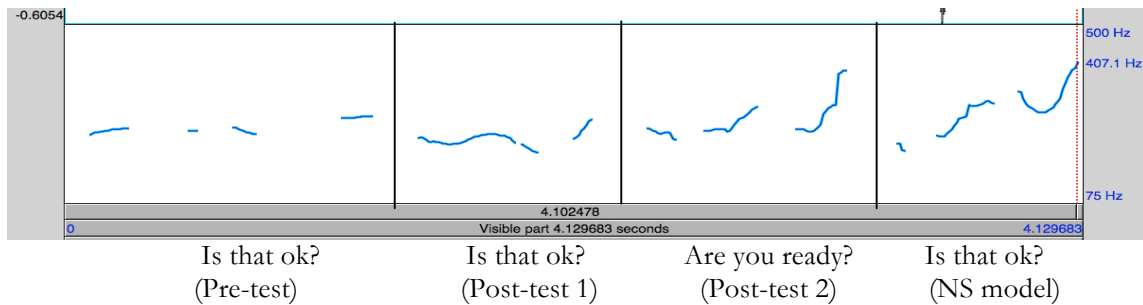
Praat. Figures 5 to 11 illustrate the pitch contours of the students whose pitch contours were almost the same as that of a native speaker’s.

For example, in Figure 5, Student #2 produced a *yes/no* question with a flat intona-

tion pattern on the pretest. However, on Posttest #1, the same student produced a question with some rising and falling intonation, and in Posttest #2, her pronunciation was closer to the native speaker's example as

she demonstrated the correct final rising intonation. These examples show that the student progressively improved as she practiced with *Praat*.

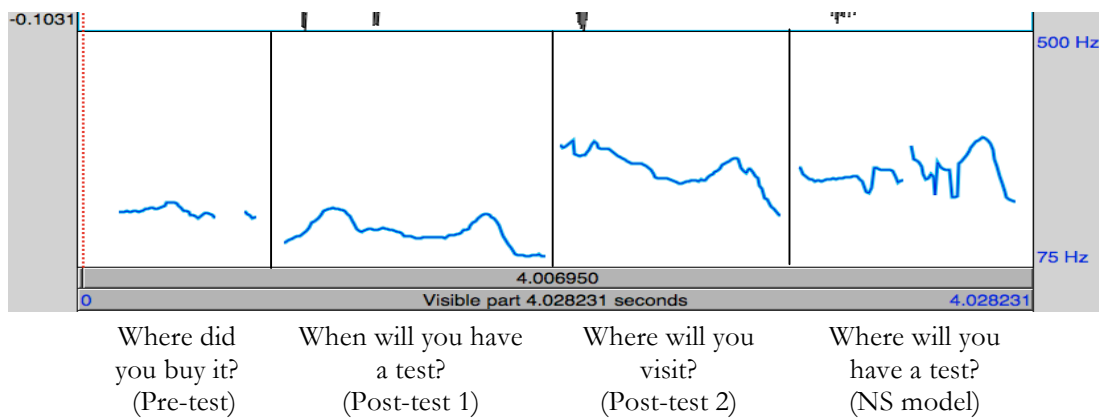
Figure 5. Visual display of the pitch contour of *yes/no* questions produced by Student #2 compared to the native speaker's model



This same student also improved in her pronunciation of *wh*-questions. Figure 6 shows that on Post-test #1, her sentence-final intonation peak occurred sooner when

compared to the native's. However, on the post-test #2, her final pitch contour was closer to that of the native's speaker's as exemplified in Figure 6 below.

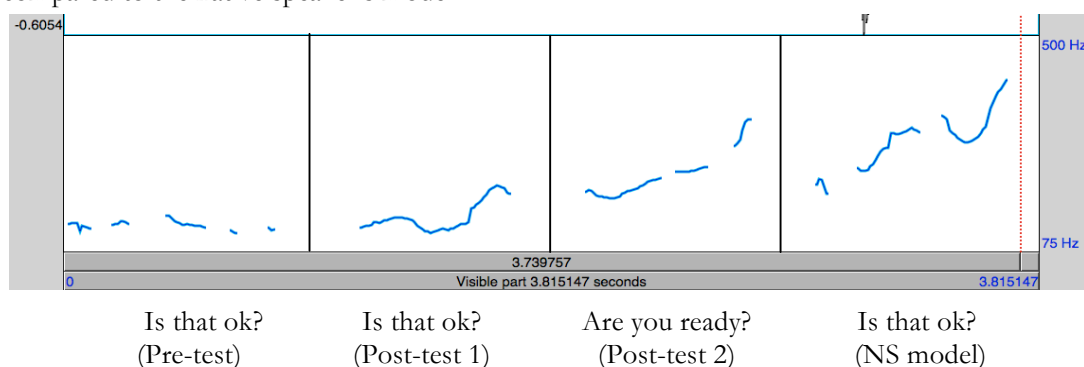
Figure 6. Visual display of the pitch contour of *wh*-questions produced by Student #2 compared to the native speaker's model



Likewise, Student #1's performance when using *Praat* showed a flat intonation curve on the pre-test, which was similar to Student #2's performance. When asked to perform Post-test 1, the student demonstrated improvement as rising and falling intonation was measured

in her utterance. Finally, on Post-test 2, she showed further improvement toward the native speaker sample as she demonstrated a more pronounced rising intonation as demonstrated in the Figure 7.

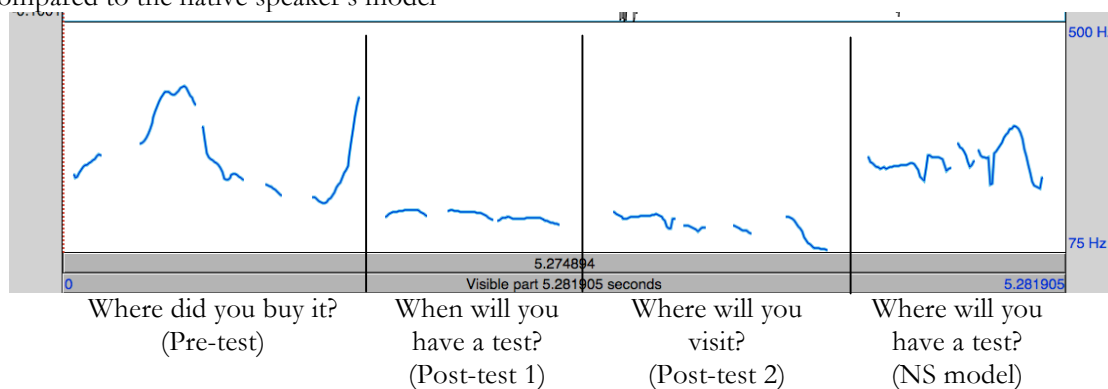
Figure 7. Visual display of the pitch contour of *yes/no* questions that were produced by Student #1 compared to the native speaker's model



When Student #1's *wh*-question utterances were examined, it is clear that she also improved from the pretest when practicing with the *Praat* software (Figure 10). In the pre-test, the student demonstrated some rising and falling intonation in their utterance; however, she erroneously completed the *yes/no* question with a final rising intonation instead of the final falling intonation of the

native-speaker model. After using the *Praat* software she demonstrated improvement on Post-test 1, especially in terms of self-correcting her final intonation so it did not rise as dramatically. Finally, in Post-test 2, while the student did not achieve the target pronunciation, she was able to produce the correct final falling intonation.

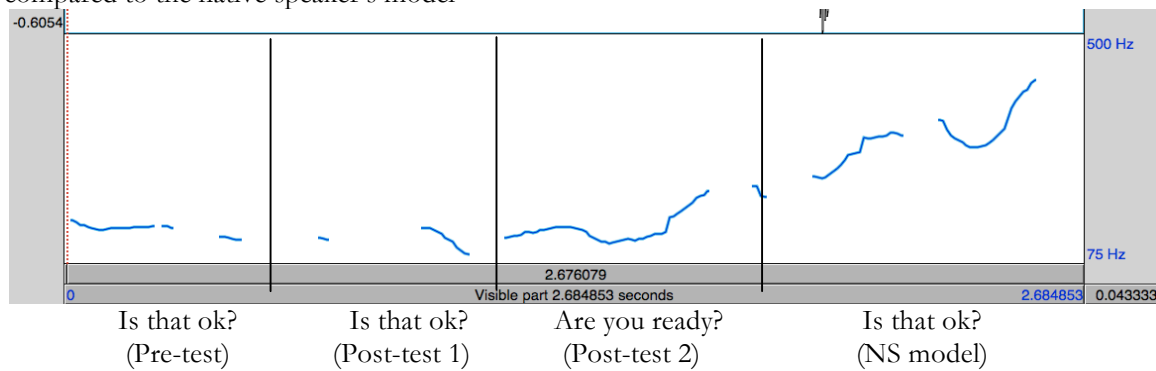
Figure 8. Visual display of the pitch contour of *wh*-questions that were produced by Student #1 compared to the native speaker's model



Student #5 saw similar improvement in his intonation pattern after self-correcting when using *Praat* software. Like the other students who made substantial improvements in their pronunciation, Student #5 also dramatically improved his final intonation curve. As seen in Figure 9 below, Student #5 produced a falling final intonation in the pre-test and Post-test #1, which did not mirror the native-speaker sample. After using the

Praat software, the student improved dramatically in Post-test 2 by producing a rising final intonation that more closely resembled the native-speaker model. Even though Student #5's post-test 2's results did not show the exact frequency of the native sample, it did show the student's ability to self correct and improve after hearing the native-sample and practicing in *Praat*.

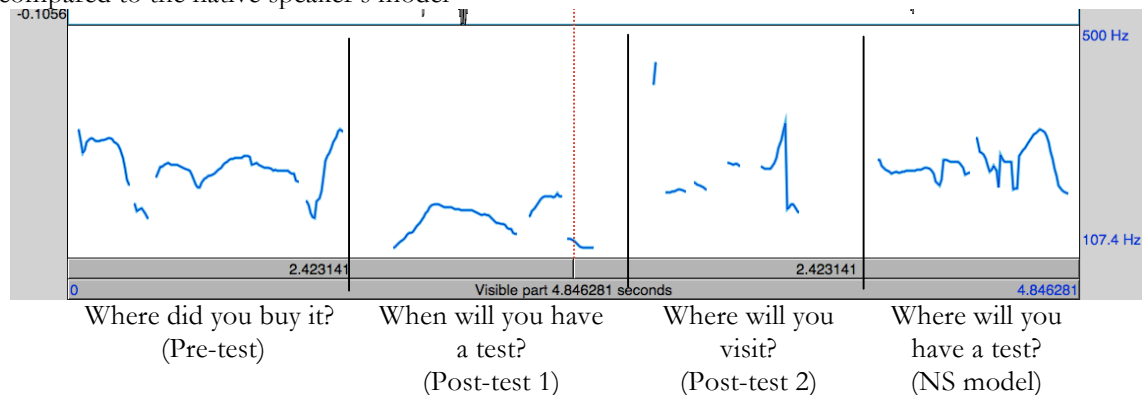
Figure 9. Visual display of the pitch contour of *yes/no* questions that were produced by Student #5 compared to the native speaker's model



Student #5 also showed dramatic improvement in his final intonation by self-correcting *wh*-questions. As seen in Figure 10 below, he once again began the study with a final intonation that did not match the native-speaker model. In the pre-test the student demonstrated a rising final intonation, which,

in post-test 1 improved to a falling final intonation. In Post-test 2, the student made further improvement as he not only retained the final falling intonation curve, but also more closely approximated the native-model's pitch.

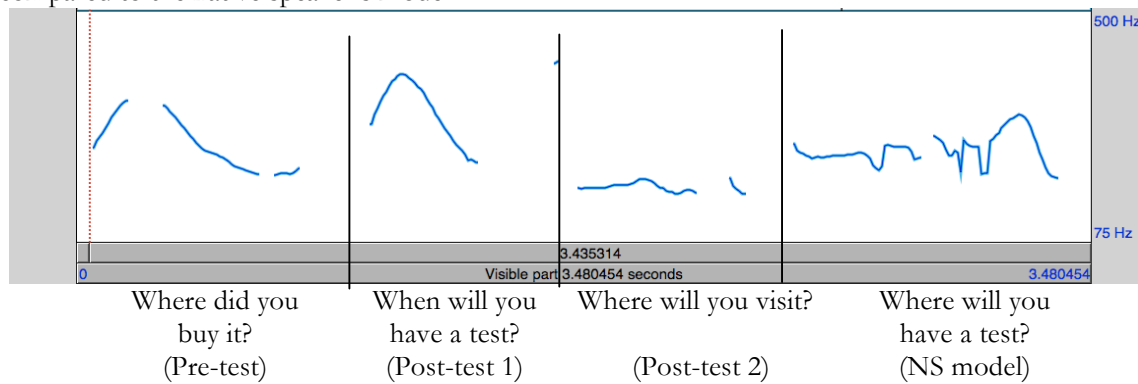
Figure 10. Visual display of the pitch contour of *yes/no* questions that were produced by Student #5 compared to the native speaker's model



Even though Student #3 also improved her pronunciation substantially after self-correcting with the *Praat* software, her improvement was different from the other students'. While the other students had improved by more closely approximating the native-speaker's intonation, those students still had some issues with their final rising or falling intonation. In the case of Student #3, she did not have difficulty with the final intonation curve and produced an utterance

quite similar to the native-speaker model. The student also improved with respect to the beginning intonation contour of her utterance. In the Pre-test and Post-test 1, she demonstrated an initial rising contour in the *wh*-question. In post-test 2, she demonstrated self-correction by eliminating her tendency to begin with a rising pitch contour and thereby more closely approximating the native-speaker model.

Figure 11. Visual of display the pitch contour of *wh*-questions that were produced by Student #3 compared to the native speaker's model



The most interesting result obtained in this research was not only the students' performance, and in some cases their improvement, but also the benefit that those learners received from working with the *Praat* software. The students had plenty of opportunities for analyzing input and practicing output and they received immediate feedback from the software, which is not always possible for a teacher to do in classroom discussions or exercises. It was the student teacher's/researcher's observation that the students seemed encouraged, motivated, and also challenged to continue practicing their pronunciation with *Praat*.

Conclusions

In conclusion, *Praat* proved to be a useful software tool for pronunciation training. By using *Praat*, students were able to record and analyze their own intonation. Thus, they could compare their voice to a model made by a native speaker, and they were able to track their progress over time. Moreover, through the use of *Praat* pronunciation teachers can quickly determine which learners need additional assistance by checking the visual feedback that was shown in the students' *Praat* screen.

There were some limitations in this study. The first limitation was the very small scale of this study as only six students of intermediate English language proficiency were analyzed. More research should be done with a larger group of students at different proficiency

levels in order to better understand the effects of *Praat* on students' pronunciation. It would have also have been advantageous for the researcher to have carried out multiple pre- and post-tests, while conducting student surveys to account for any anomalies in the data and gauging student attitudes at the time of the study. What is more, while the students were asked to approximate the native-speaker model in *Praat*, they were not instructed on how pragmatics may have an effect on intonation or pitch of an utterance. While some of the students' pitch contours and intonation did not necessarily match the native model used in the *Praat* software in some of the tests, their pronunciation would not necessarily be incorrect in certain situations such as demonstrating sarcasm, emphasis, or excitement. Importantly, the results of this study could have been strengthened by having a control group who would have produced the utterances without the assistance of *Praat* software, providing a baseline for which the use of *Praat* could be analyzed.

Further research needs to be conducted on language learners' attitudes toward *Praat* in order to explore if students like the software or if it motivates them to work on pronunciation more than with other tools. Educators might also research a student's pronunciation of questions in isolation compared to in structured or authentic discourse.

Since *Praat* software is free, easy to use, and readily accessible through a simple download it is a tool that educators can

explore through several different applications. Besides practicing intonation, teachers might ask students to use *Praat* to practice English stress since the software shows the visualization of sounds, which can help students to recognize which English words need to be

stressed and which ones do not. Furthermore, teachers might use *Praat* to assist students whose native languages are tonal to reduce transferred tones in English.

Notes

¹ A formant plot visually displays the frequency components of human speech and is

often used to study the distinctions among vowels (e.g., front vs. back, high vs. low).

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Appendix A

Pre-test

Task 1: You will record your answers. Please read the questions below aloud, and try to pronounce them clearly and naturally.

Session A

Are you ready?

Did Hansol go with you?

Do you want a candy?

Session B

Where did you buy it?

When will we have the test?

What song did she sing?

Task 2: You will record your answers. With your partner, please read the dialogue below aloud, and try to pronounce the words clearly and naturally.

(Youni come to class. She sees Jiwon there. They greet each other, and then start chatting.)

Hi Youni, you look tired today. Are you okay?

Hi Jiwon, I am okay just sleepy. I went to the International Night.

Great, Did Hansol go with you?

No, Hansol sang at the performance. She had to be there at 7. I went by myself.

Really? What song did she sing?

An English song. I don't remember its name.

Do you want a candy?

Thanks! Oh, delicious! What is its flavor? Where did you buy it?

Mango. I bought it in a candy shop in Ala Moana Shopping Center.

Do we have any homework?

No, teacher said that today, we will review for the test?

When will we have the test?

Next week. On Friday.

Are you ready?

Not yet ...

.....

(The dialogue continue)

Appendix B

Post-test #1

Task 1: You will record your answers. Please read the questions below aloud, and try to pronounce them clearly and naturally.

Session A

Did you call James?

Do you have a table for four?

Is that okay?

Session B

1. Where would you like to sit?

2. What would you like to drink?

3. When will you need it?

Task 2: You will record your answers. With your partner, please read the dialogue below aloud, and try to pronounce the words clearly and naturally. One of you will be the Waiter and Customer 2. The other student will be Customer 1.

(One customer comes to a cafe. He is talking to a waiter while waiting for his friends ...)

Waiter: Good evening!

Customer 1: Good evening!

Customer 1: Do you have a table for four?

Waiter: Yes, sir. Where would you like to sit?

Customer 1: Inside please?

Waiter: We have a table inside by the window. Is that okay?

Customer 1: That's great. Thank you.

Waiter: What would you like to drink?

Customer 1: Just water with lemon, please.

Waiter: OK.

Customer 1: Today is my friend's birthday. Do you have a birthday cake?

Waiter: Yes, sir. When will you need it?

Customer 1: After the meal, please.

Waiter: Yes, sir. I'll be right back.

Customer 1: Hi Jack, how are you doing?

Customer 2: Good! How are you?

Customer 1: I'm enjoying myself! Hey, did you call James?

Customer 2: Yes, I did. Will Sally be here, too?

Appendix C

Post-test #2

Task 1: You will record your answers. Please read the questions below aloud and try to pronounce them clearly and naturally.

Yes/no questions:

1. Will Sally go with you?
2. Are you going home?
3. Do you like your job?

W/b questions:

When will you leave?

What will you do?

Where will you visit?

Task 2: You will record your answers. With your partner, please read the dialogue below aloud and try to pronounce the words clearly and naturally.

(Youni is going to class. She sees Jiwon on the street. They greet each other, and then start chatting.)

Hi Youni, How are you doing?

Good! How are you?

I'm fine. Thank you.

I heard you are going to Europe for vacation. When will you leave?

Next Monday.

Where will you visit?

I will visit Denmark, France, and Sweden.

Cool! Will Sally go with you?

No, she is visiting her family. Are you going home?

No, I will be here.

What will you do?

I am working for my brother. He has his own company.

Good. Do you like your job?

Yes, it's a tourist company. I'm enjoying meeting people from different countries.

.....

(The dialogue continues)