Accommodating Learning Styles: An EFL Pronunciation Course for Science and Engineering Students

Ralph L. Rose
Waseda University
rose@waseda.jp

Abstract

This paper describes a course in pronunciation for science and engineering students studying English as a foreign language in Japan. The course is designed to address the pronunciation needs of science and engineering students while simultaneously catering to the sensory, visual, and active learning styles of these students as well as their interest in and higher aptitude for math, physics, and technology. Students are introduced to the sound system of English and use computer-based tools to look at graphic representations of their own voice, comparing it to those of native speakers. Students learn how to diagnose their own pronunciation problems and develop skills so that they may continue their pronunciation development long after the course is finished through autonomous learning. Keywords: learning styles, pronunciation, EFL, learner autonomy

Introduction

Many graduates of science and engineering academic programs go on to positions that require them to use English as a lingua franca to communicate with other professionals in academic and commercial collaborations. Thus, science and engineering students who use English as a second language need to develop an English pronunciation proficiency high enough for comprehensibility among other English speakers (both native and nonnative). This includes a consistent speech accent which is recognizable to other speakers. It also includes mastery of the pronunciation of much technical jargon, which, although possibly borrowed into the students' native language, may have pronunciations which differ significantly from the English pronunciations.

In order to address these needs, explicit pronunciation instruction may be given to science and engineering students to better prepare them for their future collaborations in English. But what kind of pronunciation instruction is most suitable for science and engineering students? In this paper, I will offer one answer to this question, taking the dominant learning styles of science and engineering students as a starting point. I will discuss these learning styles and then describe a specific course design which is currently in practice at my university. This design involves using computer-based tools that give graphical representations of students' pronunciation, allowing them to diagnose their own pronunciation shortcomings through comparison with native speaker models. Finally, I will wrap up the paper with some discussion of future directions in pronunciation training for science and engineering students.

Learning styles of science and engineering students

While gauging student needs is crucial for the development of any successful syllabus, it is also important to recognize that students do not all approach learning in the same way. These differences have been referred to as learning styles (see [1] for a detailed overview and critical review of several different learning style models). One model that has been used to assess the learning styles of science and engineering students is the Felder-Silverman model [2]. In this model, learners are characterized according to five dimensions, as follows.

Sensory-Intuitive: Sensory learners prefer to perceive the world through the senses while intuitive learners prefer to do so through introspective means.

Visual-Auditory: Visual learners pay more attention to what they see, while auditory learners pay more attention to what they hear, and each may tend to miss or ignore input they receive through the other modality.

Inductive-Deductive: Inductive learners learn better by observing various phenomena and inferring principles from them. In contrast, deductive learners prefer to take existing principles and draw conclusions relevant to specific cases.

Active-Reflective: Active learners prefer to learn new things through physical activity such as experimentation. Reflective learners, on the other hand, prefer to learn new

978-1-4244-8144-6/10/$26.00 ©2010 IEEE

things through internal reflection. Although seemingly similar to the Sensory-Intuitive dimension, the Active-Reflective dimension is different: A sensory learner may perceive some phenomenon through the senses, but then may prefer to consider it introspectively in order to learn from it.

Sequential-Global: Sequential learners prefer to learn about something in an organized manner, where information is presented to them sequentially from start to finish. Global learners, however, tend to learn more erratically, perhaps showing no progress at all for a while, and then suddenly getting the big picture.

Numerous studies of the learning styles of science and engineering students have been performed, and results consistently show that they prefer sensory, visual, and active learning [3, 4]. In regular science and engineering classes, this has led to a greater emphasis on experiential learning with in-class physical demonstrations and laboratory experiments. These learning preferences form the foundation for the EFL pronunciation course which is described in the next section.

Learner autonomy

Second language pronunciation development—no matter how it takes place—requires time. This is especially true for learners who begin learning the second language later in life. Even with direct, explicit instruction, it is unusual that learners show immediate improvement in their pronunciation. Therefore, it is important that learners continue a program of pronunciation practice even after the regular course is finished. This means that students need to become autonomous learners [5, 6] (cf., "learner strategies" [7, 8]). According to [6], autonomy is "…the ability to take charge of one's own learning" (p. 3). It crucially involves three things: determining goals, deciding how to reach those goals, and measuring progress toward those goals.

While much research on learner autonomy has focused on how to increase autonomy within the educational context (e.g., in the classroom, in self-access centers), recently there are have been some calls for attention on how to encourage autonomy outside the educational context; that is, after the course is finished, or even after the learner leaves the institution. This has been referred to as "continuing learning" [9] and "external learning" [10].

In addition to taking science and engineering students' learning styles as a foundation, the course described below also seeks to develop students' external learning skills so that they will be prepared to continue their pronunciation development autonomously in the future.

Pronunciation course

The pronunciation course described here is one course in a larger program of English as a foreign language instruction at Waseda University Faculty of Science and Engineering in Tokyo, Japan. During their first two undergraduate years, students are required to take a sequence of courses designed to improve their oral and written communication skills as future scientists and engineers in Japanese and international corporations. From the third year, students may choose from a variety of elective courses that focus on such areas as technical writing and presentation, workplace English, and TOEIC test preparation. The present course is one of these elective courses and is titled "Special Topics in Functional English: The Sound System of English" (hereafter, STFE-SSE).

In this section, I will explain the course in detail, first by describing the basic design and then some of the key resources that are used in the course. In the latter part I will show some sample classroom activities and then describe the final projects.

Design

The primary objectives of STFE-SSE are as follows.

1. Understand and be able to talk about the fundamental concepts of (acoustic) phonetics and phonology in English.
2. Understand and be able to describe some of the key phonological and phonetic features of the English language in English.
3. Use specialized software to measure and analyze acoustic recordings of English speech.
4. Design and carry out a small-scale experiment looking at some phenomenon of the English sound system.
5. Present findings from the above experiment in English in both oral and written forms.

The course addresses students' needs while catering to their learning styles by taking advantage of several computer-aided instruction techniques. In particular, objectives (3) and (4) are most directly related to the learning styles of science and engineering students: The use of special tools to look at acoustic wave patterns appeals to their sensory learning style, while the in-class experimentation appeals to their visual and active learning styles.

The basic content of the course is similar to that of many introductory acoustic phonetics courses, covering such topics as the International Phonetic Alphabet (IPA), the fundamentals of acoustic phonetics (e.g., waves, formants, tube model of articulation), and the sound system of English (e.g., vowels & consonants, syllables & words, stress & rhythm, intonation).

This design has the added advantage of building on science and engineering students' higher aptitude for math and physics concepts, while reinforcing their learning of those topics in their core science and engineering curriculum.

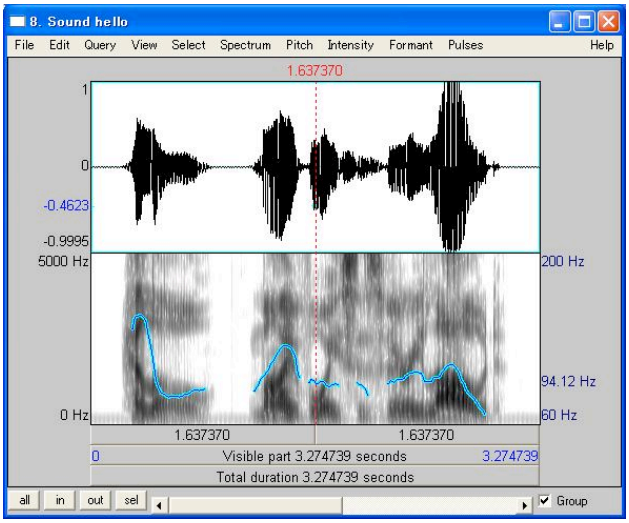

Figure 1. Waveform and spectrographic analysis features in Praat.

Resources

There are two resources that are crucial to the design of the course. The first is *Praat* [11], which is a freeware tool for waveform and spectrographic analysis (see Figure 1). It is a cross-platform application which is highly portable and can be run from a memory stick without any special installation procedure.

Using Praat gives students the ability to receive useful *electronic visual feedback* [12]: Students learn how to use Praat to make recordings of their own speech, measure relevant phonetic features of the recording, and then evaluate their own pronunciation ability.

Other applications besides Praat could suffice here (e.g., the open-source applications *Audacity* or *WaveSurfer*), but in the present educational context, Praat's portability made it the most practical choice.

The second important resource is the Speech Accent Archive at George Mason University [13]. The archive consists of recorded elicitations of the same source text from over 1,200 different speakers of English—both native and nonnative. For each speaker, an audio recording is available plus a detailed IPA transcription of their speech as shown in Figure 2. As a result, learners may browse this archive to listen to different varieties of English, and then they may compare their English accent to common native English accents. The archive further identifies some samples as representative samples of regional accents. This makes it easier for students to identify which regional accent their own nonnative accent most closely resembles.

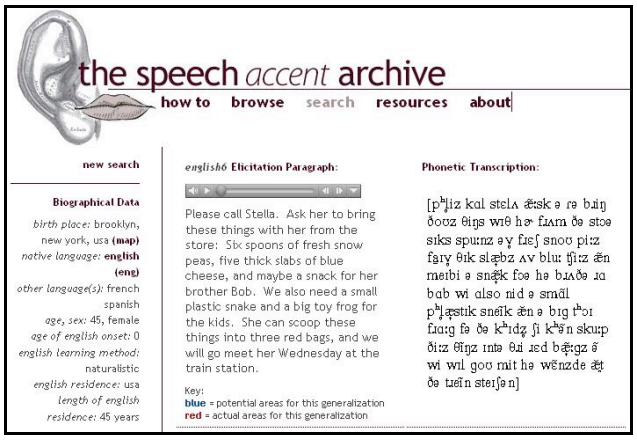

Figure 2. Sample data from the Speech Accent Archive at George Mason University.

Classroom activities

The classroom activities consist mostly of lectures on the sound system of English, interspersed with various self- or group-directed tasks which are designed to give some practical confirmation of the content, or help to develop their skills at self-assessment of pronunciation.

For example, one activity is designed to help students see that English is a stress-timed language (i.e., stressed syllables are lengthened and unstressed syllables are shortened so that stressed syllables fall at regular intervals in contrast to non-stress-timed languages such as Japanese). Students record poems (e.g., "Roses are red, violets are blue …") and measure the duration between stressed syllables to verify the timing. Alternatively, students record stress with additional unstressed syllables and check that the time remains constant. That is, the following three sentences (from [14]) should all have approximately the same total duration because the number of stressed syllables is constant.

CATS EAT MICE.

The CAT will EAT the MICE.

The CAT will have EATen the MICE.

Another activity involves students reading an elicitation paragraph, measuring the vowel formant pairs (F1, F2), plotting them in a graph using Excel, and then comparing the resulting vowel distribution to that of the typical native speaker. Figure 3 shows sample results from EFL learner 1. A quick glance at the figure makes it clear that this speaker has trouble distinguishing the two high back vowels (u/ ʊ as in *cooed*/*could*).

Figure 4 shows sample results from EFL learner 2. Here, the graph readily shows that the student is producing all the vowels closer to the front of the oral cavity (leftward in the figure)—a phenomenon called *fronting* and sometimes attributed to ethnic minority groups in the US [15].

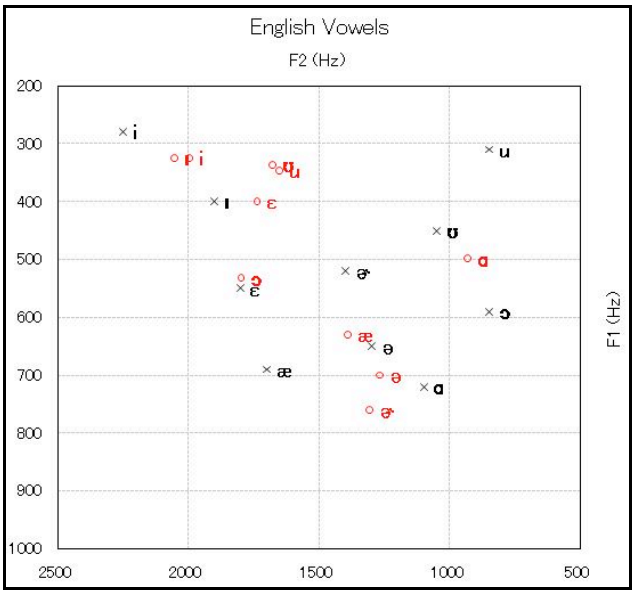

Figure 3. Sample vowel distribution of EFL learner 1 (red ◦) and typical native speaker of English (black ×).

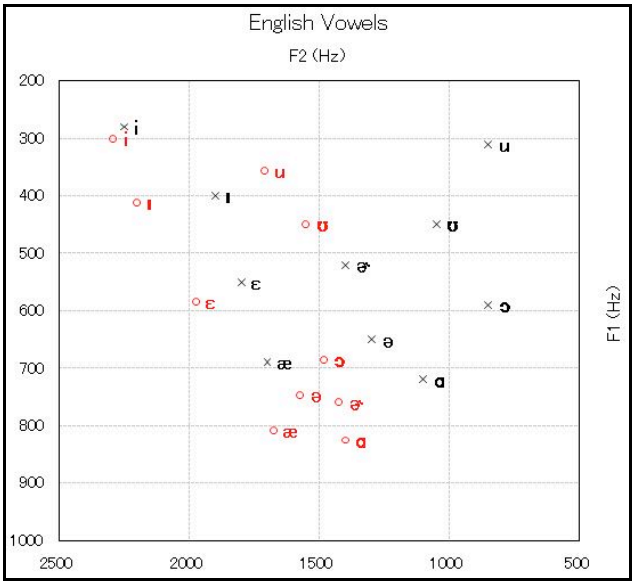

Figure 4. Sample vowel distribution of EFL learner 2 (red ◦) and typical native speaker of English (black ×).

(Note: The Excel spreadsheet used to plot the data is adapted from a template found at [16], using native speaker values taken from [17].)

Final projects

The latter part of the course involves project work in which students take one of two directions: a small-scale research project on some phenomenon of the English sound system (i.e., reduction patterns, contrasts with the Japanese sound system) or the creation of an individualized program of pronunciation development based on an extensive self-evaluation of their pronunciation. In both cases, students must carry out the problem-solution parts of the research process, thereby reinforcing this important scientific construct. In short, a primary goal is to develop learner autonomy [5], [6] in pronunciation development so that students may work on improving their pronunciation skills autonomously.

Discussion

STFE-SSE addresses science and engineering students' needs by taking their preferred learning styles as sensory, visual, and active learners as a foundation, and engaging them in various activities that prepare them for EFL pronunciation development in the long term. Students also learn the skills that are necessary for them to diagnose their own pronunciation problems and then measure their progress toward correcting those problems, preparing them to be autonomous learners even after the course is finished. In short, learners become linguists, as recommended in [9]: "We can train them to be their own language researchers…" (p. 343).

One limitation of this course is that it may be somewhat difficult to adapt to other institutions. For instance, the design requires a computer laboratory for regular classes with computers that are enabled for audio recording and playback. In some institutions, the use of such specialized classrooms may be limited. In addition, the current design of the course requires some specialist knowledge in acoustic phonetics. This is particularly crucial when teaching students how to look at and interpret waveform and spectrographic representations of their voices. For instructors who wish to implement this course but are not confident in their knowledge of these areas, there are a wide variety of resources available on the Internet to review these topics.

Conclusion

At present, there is no empirical data on the effectiveness of this course. At the moment, gathering such data is left to future work. However, there is much anecdotal evidence of the course's influence on learners' motivation and self-awareness of pronunciation issues. One example is the case of a student who discovered that he could use various functions in Praat to "improve" his pronunciation. Upon analyzing his speech, he found that he was producing many extraneous sounds in English (epenthetic vowels, to be specific) which native speakers do not produce. Using Praat, he located these sounds, cut them out, and created a smoother, more native-like sound in his voice. In his final project presentation, he enthusiastically explained how this was done and how he "improved" his pronunciation. In short, the course accommodated his learning style in a way that gave him the tools to be able

to diagnose his pronunciation problems and correct them on his own.

References

[1] Coffield, F., D. Moseley, E. Hall, and K. Eccleston, *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review*, Learning Skills and Research Centre, London, 2004

[2] Felder, R.M. and L.K. Silverman, Learning and Teaching Styles in Engineering Education, *Engineering Education*, 78:674-681, 1988.

[3] Felder, R.M. and R. Brent, Understanding Student Differences, *Journal of Engineering Education*, 94:57-72, 2005.

[4] Kolmos, A. and J.E. Holgaard, Learning Styles of Science and Engineering Students in Problem and Project Based Education, *Proceedings of the European Society. for Engineering Education*, Aalborg, Denmark, 2008.

[5] Benson, P., *Teaching and Researching Autonomy in Language Learning,* Longman, London, 2001.

[6] Holec, H., *Autonomy and Foreign Language Learning,* Council of Europe, Strasbourg, 1979.

[7] Wenden, A., *Learner Strategies For Learner Autonomy,* Prentice Hall, London, 1991.

[8] Wenden, A. and J. Rubin (Eds.), *Learner Strategies in Language Learning,* Prentice Hall, Englewood Cliffs, NJ, 1987.

[9] Harmer, J., *The Practice of English Language Teaching, 3rd Edition*, Longman, London, 2001.

[10] Field, J., Looking outwards, not inwards, *ELT Journal*, 61:30-38, 2007.

[11] Praat, a system for doing phonetics by computer, *Glot International*, 5:341-345, 2001.

[12] Anderson-Hsieh, J., Using electronic visual feedback to teach suprasegmentals, *System*, 20:51-62, 1992.

[13] Speech Accent Archive, http://accent.gmu.edu, George Mason University, Fairfax, Virginia, USA.

[14] Dauer, R., *Accurate English: A Complete Course in Pronunciation*, Regents/Prentice Hall, Englewood Cliffs, NJ, 1993.

[15] Labov, W., S. Ash, and C. Boberg, *The Atlas of North American English*, Mouton de Gruyter, New York, 2006.

[16] Deterding, D., Measuring and Plotting Vowels, http://videoweb.nie.edu.sg/phonetic/vowels/measurements.html, accessed on 29 April 2009.

[17] Deterding, D., The North Wind versus a Wolf: short texts for the description and measurement of English pronunciation, *Journal of the International Phonetic Association*, 36:187-196, 2006.

About the Author

Ralph Rose has been teaching EFL for more than twenty years in both Japan and the United States. He currently works in Japan at Waseda University in the Faculty of Science and Engineering and together with eight colleagues, oversees an English program serving 10,000 undergraduate and graduate students. His research interests include topics in Applied Linguistics, Psycholinguistics, and Computational Linguistics.