LABORATORY ACTIVITIES FOR LARGE AND ONLINE PHONETICS CLASSES

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ABSTRACT

Phonetics is an inherently lab-oriented topic, involving the investigation and analysis of speech data; but it is often taught in large sections with limited instructional time and other resources, so instructors are unable to engage in the deep interactive explorations of topics that would be ideal. We present three phonetics laboratory activities designed to address this problem. In addition, these activities can engage students in material in ways that are not possible in a primarily lecture-based course; they can provide a source of empirical data for use in longitudinal research; and they can give students a taste of the experimental investigations from which much of the material in their course derives. We discuss pedagogical goals, activity design and grading. We also discuss challenges and successes in the implementation of these activities.

Keywords: laboratory activity, large class, online

1. INTRODUCTION

At our university, as in many programs, an introductory course in phonetics is a core part of a degree in linguistics. Introductory phonetics is a second-year course for undergraduate students and is often the second or third linguistics course taken as part of their program. Phonetics is a prerequisite for many more advanced courses, such as phonology, speech perception, acoustic phonetics, and language acquisition. It also fulfills requirements in other degrees such as English as a Second Language taught in Education. In Canada generally, degrees in speech-language pathology are offered only at the Masters level and an introductory course in phonetics is often a prerequisite for admission. As a common prerequisite, our introductory phonetics class comes under heavy demand, with total annual enrolment often exceeding 150. Per-course enrolment in a normal academic semester often ranges from 50 to 80. These per-course numbers are likely to increase due to lack of funding to offer additional sections.

We have also seen increasing interest, from students at universities where a phonetics course is not offered, in taking this course online. This is related a wider trend internationally, noted in [6], toward more interactive online and digital content in phonetics courses. Although we are aware of several other online phonetics courses that have been offered internationally (for example, see [3, 4]), it appears that no such distance course is currently offered in Canada. We have developed this course in an online format to meet the demands at both the local and national levels.

We work with the belief that a phonetics course should be a laboratory-based course. However a laboratory-based course with either large enrolment numbers or students taking the course at a distance (online) presents a challenge to this belief (see also [2]) and raises a fundamental question: Can we teach this material and continue to provide students with a hands-on learning experience? We do not claim that these laboratory activities are novel in any way and we are aware that many of these types of activities are implemented in many similar classes around the world. In fact much of the content of the current labs is based on examples from others.

The present paper reports our experience in modifying and developing three instructional laboratory activities for online and large-course delivery. These activities have been piloted with students in both on-campus and online courses.

2. INSTRUCTIONAL LABORATORY ACTIVITES

In this section we provide details about the overall course delivery; then we describe three laboratory activities and their major components. We provide a brief description of the purpose of each assignment, and describe the content of the assignment in detail. We then provide a brief evaluation of the success of each activity and plans for continued refinement.

The course material is delivered in two ways. The first is as a conventional on-campus lecture style course, typically delivered as 3 hours of lectures each week for a 12-week course, or 6 hours per week for a 6-week course. The second is as an online course, delivered using video lectures and extensive electronic dialogue with students (via email, video conference and a chat room). In both formats, assignments and quizzes are given to

students through our online learning environment, Moodle [7], to complete on their own. Assignments have fixed due dates, and quizzes are available for students to write them over approximately a 48-hour window. All courses include a final examination. The course is designed to offer online students and on-campus students the same content and, as far as practical, a similar experience.

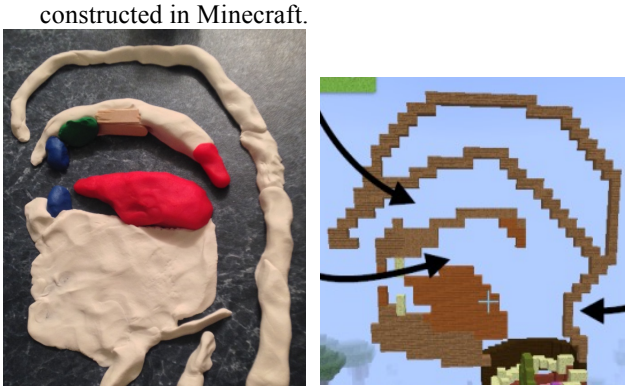
The assignments are designed to address two key learning objectives: they give hands-on experience in discovering and learning about phonetics, and they give students and opportunity to apply what they have learned from the material presented in lectures. The three selected laboratory activities address different core topics in our phonetics curriculum: Articulation, Acoustics, and Speech Perception.

2.1. Articulation: "Frankentract"

2.1.1. Target outcome

Seventeen anatomical structures are discussed in our course. Some, such as the lungs and lips, are already familiar to students when they enter the course. Others, such as the cartilages of the larynx or parts of the palate, are not. Students learn to identify these structures, and they learn how these structures are used in the production of speech sounds. The Frankentract activity gets students to think creatively about how anatomy and speech production work together.

Figure 1: Sample "Frankentracts" created by students in introductory phonetics. The one on the left is made of clay; the one on the right is constructed in Minecraft.



2.1.2. Activity structure

This activity asks students to construct an artificial vocal tract using convenient materials in their environment. They are encouraged to build a physical model. They may instead make a digital or hand drawn schematic, create an image of it, and submit the image. See Figure 1 for two examples (reproduced with permission). Along with the image, they submit a write-up that details how the artificial analogues of each anatomical structure covered in class is constructed and how the materials and construction would affect its function in the speech production system. Artistic ability and acoustic function of the construct are not graded.

2.1.3. Discussion

Although drawings would be easier for most students, a significant portion of students (38%) choose to physically construct a model. We take this to indicate that students are enjoying the material, and they are motivated to engage with it beyond what is required in the graded evaluation.

The main difficulty at first for this activity was making the scope clear to students. Having a specific list of which specific structures they are expected to address has helped. So has reminding students that the purpose of the activity is to demonstrate that they understand how the anatomy functions to generate speech and that they won't be graded for number of hours spent developing the model.

A second challenge, common to all of the activities discussed here, is calibrating the time spent assessing the assignments. Even a cursory scan of each submission to ensure the student has mentioned all 17 structures and made relevant comments becomes time consuming in a class of 50 or more students.

Overall, students show creativity in their constructions and exhibit understanding in their write-ups. This demonstrates to us that this is a successful exercise, from the instructor's perspective. Informal feedback from students suggests that they find it enjoyable as well.

2.2. Acoustics: "English Vowel Spaces"

2.2.1. Target outcome

The English Vowel Spaces activity connects students directly with the acoustic characteristics of speech sound by having them record their own vowel productions, measure the formants, and reason about how these measurements relate to the patterns discussed in class. A secondary pedagogical goal is the aggregation of data across all students in a class to produce formant plots, to compare against published formant spaces in the literature. This forms an interesting follow-up analysis that can be undertaken in class.

2.2.2. Activity Structure

Students are given written instructions for the assignment on the course website. The instructions direct students through the process of using Praat [4] phonetic analysis software to record twelve standard [hVd] words, measure the first three formant values of the vowels, and record these values. They then discuss the patterns observed with respect to the patterns discussed in class. Does F1 pattern with vowel height as expected? Does F2-F1 distance pattern with vowel frontness as expected? Students are encouraged to discuss apparent anomalies and to speculate on reasons.

They submit a report that includes their formant measurements for each target vowel, as well as a one-page discussion of the patterns they observe in those measurements. They may also choose to input their measurements (along with limited demographic information - see section 3 below) into a form that adds their data to the longitudinal dataset.

2.2.3. Discussion

The main goal of this lab activity is to reinforce the basics of acoustic phonetics. It also provides students with experience interacting with their own data. For an instructor to manually check reported formant values against the sounds is implausible, either in the large on-campus course or in the intensive online course. Feedback on measurement accuracy is limited to noting implausible values, without penalizing student grades. Measurement errors, such as mistaking the voice bar for F1 (and the consequent shift – identifying F1 and F2, etc.) can be discussed in class. However, there is no straightforward way to check whether students have assimilated this instruction.

A plot aggregated across the whole group can then be used as an illustration in class lectures after the data have been collected. A series of R scripts [3] is used to generate a plot in class as in Figure 2 so that students can also see the process.

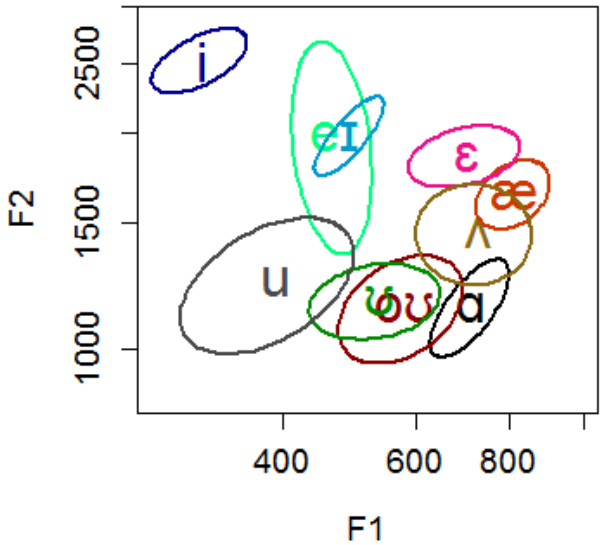


Figure 2: Sample aggregate vowel plot (logged axes) from student data, with ellipses one standard deviation from the mean.

The use of a Google form for students to add their data to the accumulating pool of measurements has presented a challenge to students and we have found that some time in class or in an online video is needed to demonstrate how they are to carry out this exercise.

This lab activity offers students a chance to apply their vowel acoustics knowledge to their own speech. It further engages students with their own speech and allows them to compare it to others.

2.3. Speech Perception: "Incomplete Neutralization"

2.3.1. Target outcome

This activity is an extension and illustration of patterns of perception that are covered in class. In particular, it gives students an opportunity to see what sort of evidence linguists use to measure and analyse phonetic and phonological phenomena in languages.

2.3.1. Activity Structure

Students are given an experimental setup to explore the "neutralization" of /t/ and /d/ in the environment where both are produced as a flap [ɾ] in Canadian English (after a stressed syllable nucleus and before an unstressed syllable nucleus). The theoretical question of interest is presented, and students are given five word pairs, such as "ladder"/"latter" and "wider"/"whiter". They are to produce these words naturally (avoiding hyperarticulation, which can interfere with flapping) and have a listener note, for each production, which item in the pair they think they heard. They perform this for five listeners, generating a total of 50 data points (1 production each for 10 words with 5 listeners).

Students are asked to submit a report of their results, including brief introduction, methods, results, and discussion sections. Some of this is

simply a restatement of the assignment instructions in their own words. They also look for patterns and comment on them using their understanding of speech production and perception.

2.3.5. Discussion

Many students find evidence for incomplete neutralization. In addition, Canadian raising has a huge impact on perception in the diphthongs (like "whiter"/"wider"). Students often find variation stemming from differences in language background (non-native vs. native speakers) and age (older vs. younger). Often half or more of the student population is non-native, which impacts the results.

Because this activity is undertaken under widely varying conditions by different students (different language backgrounds for the speaker and listener, different acoustic environments, etc.), not all students find good evidence of incomplete neutralization. While it is a good illustration for those students who do find incomplete neutralization, its illustrative value for others is unclear. Different stimulus sets or phenomena might be better suited to the pedagogical goals of the activity, but it is unlikely that in a linguistically heterogeneous student population, a single phonological pattern can be found that is broadly reliable. Using flapping, a pattern common in the dominant local dialect (Canadian English), probably gets the best results we can expect.

3. GENERAL DISCUSSION

Phonetics can have a "high 'wow' factor – the scope for fun and impressive demonstrations is vast." [1] However, such demonstrations often require direct interaction that is not always convenient (e.g., in large classes) or even possible (e.g., in online classes).

We have attempted to create engaging activities that give students the opportunity to demonstrate their understanding of the material, to engage directly by producing their own models (Frankentract), data (English Vowel Acoustics), and experimental stimuli (Incomplete Neutralization).

These activities continue to require refinement. One challenge related to these activities is the time required to mark them. Possible solutions include: (1) hiring teaching assistants to carry some of the marking load; (2) switching activities from graded-with-feedback to participation marks (automatic submission credit), while offering model answers; and (3) enacting a peer-marking scheme. Each of these options has advantages and disadvantages in terms of resources, quality and depth of feedback, and logistical complexity.

We are carrying out a review using targeted student surveys as well as analysis of aggregated grade outcomes to determine how successful each activity is in engaging student interest and reinforcing the course content. We are also comparing online versus on-campus delivery of the course, to establish how well the activities translate between different teaching modalities. We plan to continue developing further activities as graded material or optional enrichment exercises.

One of the interesting possibilities of the English Vowel Spaces activity is that it can also be used longitudinally for both research and pedagogical purposes. Assuming the proper ethical procedures have been established and informed consent has been obtained, the data can be gathered and kept for research purposes. These data can be used in two ways: (1) for continued pedagogical purposes – the data from previous classes can be compared to the current class; and (2) as a research object, as documentation of the vowel system of the local dialect and more generally of the students taking the course. Obtaining empirical research data in this way is beset with difficult-to-overcome confounds. Students are a heterogeneous and non-random sample (widely varied language backgrounds and ages, among other things). One major challenge in using these data for research is verifying the accuracy of submitted measurements (for example, there are several errors in the data presented in Figure 2). We are currently trying to devise a means by which students can submit their recordings alongside the measurements, allowing for spot-checks.

4. CONCLUSION

While we are still in the process of formally evaluating the success of these activities and differences in the delivery types, we feel that these activities have been successful in allowing our students to get more hands-on experience with phonetics. This experience is an essential part of a phonetics course, even with the challenges presented by a large-class and online presentation modes. We are committed to creating an engaging, interactive class and not a course where students are only expected memorize material and take a test. We hope in sharing our experience, after the example of [5], that more activities of this sort will be reported and the potential for sharing will increase.

5. REFERENCES

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