

The Effectiveness of Explicit Articulatory Instruction
on the Production of French Vowels by Native
Speakers of American English

Kennedy VanPelt

Advised by Lisa Davidson

New York University

2019

1. Introduction

1.1 Teaching pronunciation

Many teachers are reluctant to correct pronunciation, despite the fact that students have been documented as saying they would prefer their teachers to correct them more (Cathcart and Olsen 1976) and that oral corrective feedback has shown greater student improvement (Lyster and Saito 2010). Many teachers view teaching pronunciation as boring and monotonous, with most of the work consisting of strictly structured tasks and/or repetition drills (Baker 2013). The teachers' attitudes toward these exercises affect not only the way in which the material is presented, but also the energy with which the students respond to and participate in the lesson. In short, if the teachers are not excited about the material, the students will not be either.

1.2 Teaching the teachers

Teachers often do not receive sufficient training/instruction for teaching pronunciation. Even if pronunciation pedagogy training were a mandatory part of educating foreign language (L2) teachers, more research needs to be done to shape the content and structure of such training. Up until now, "...classroom-oriented research informing practitioners about effective methods of pronunciation teaching has been lacking." Due to this lack of insight, "...teachers have oftentimes been faced with conflicting information about how best to address this skill" (Brinton 2018).

When provided training, teachers have been shown to put this information to good use. Baker (2013) found that the three (out of five) TESOL instructors in her study who had previously taken a formal class on pronunciation pedagogy were measured as having the most numerous and diverse exercises for teaching and practicing pronunciation. In the current system, even when teachers *are* trained to teach pronunciation, there is almost no input from potentially valuable linguistic research. As Derwing and Munro stated in 2005, "...the study of pronunciation has been marginalized within the field of applied

linguistics. As a result, teachers are often left to rely on their own intuitions with little direction¹.”

1.3 Previous research on pronunciation instruction

Recent syntheses addressing the effectiveness of pronunciation instruction have helped to tease out the different relevant aspects of teaching pronunciation. In his 2012 synthesis of 15 studies, Saito found that studies involving controlled contexts consisting of “mechanical drills and choral repetition without much elaboration” show no student improvement. These studies were analyzed in contrast to those that consisted of communicative contexts such as debates and other “meaning-oriented” activities in which the instructor, other students, or both were encouraged to give feedback on pronunciation (Saito 2012). The latter studies (consistently) showed improvement in the students’ pronunciation. In a comprehensive synthesis of 86 studies of pronunciation instruction, Lee et al. (2014) supported the cause of the importance of feedback in pronunciation instruction and found that methods centered around technology were less effective when compared to human instructors.

Unfortunately, though these syntheses argue the relative effectiveness of pronunciation instruction in different contexts and make a case for the importance of a deeper understanding of this area of L2 instruction, they lack “...a more fine-grained analysis of the effects of different types of pedagogical practices” (Lee et al. 2014). The majority of studies looking into the effectiveness of pronunciation instruction draw conclusions on environment and structure of practicing pronunciation rather than on the explanations and materials used to teach the sounds themselves. For example, based off of the conclusions drawn by Saito and Lee et al., pronunciation instruction should be led by human instructors, involve feedback from both the instructor and peers, and be given

¹ These difficulties are not only experienced by non-native instructors. In fact, research has shown that, “...like other language skills, instruction on pronunciation skills is more dependent on knowledgeable teaching practices than on native pronunciation of the teacher,” supporting the claim that more comprehensive training for teaching pronunciation would be beneficial for *all* L2 instructors (Levis et al. 2016).

in the context of communicative activities; these findings, while helpful, still leave instructors with little direction for exactly how to guide the students' production of individual target sounds.

Previous research on providing students with explicit articulatory information has mostly involved awareness of articulation. These studies typically contain ultrasound technology where wherein the learner is shown the formation of the tongue during the production of different sounds (Gick 2006). While this approach has shown some positive results, ultrasound technology is not easily accessible and not realistic for a classroom setting.

Articulatory instruction has been shown to improve production in other contexts. In Lin's (et al.) 2019 study, phonetic training and visual feedback (ultrasound) both proved to be useful in improving English speakers' production of a novel consonant contrast. The participants repeated a recording of a native Marathi speaker producing a single stimulus that contained either a dental or a retroflex stop. They were then separated into three different groups. The first received a short phonetic training accompanied by mid-sagittal diagrams, the second watched mid-sagittal ultrasound videos of the native Marathi speaker producing the stops and also live ultrasound of their own tongues, and the third received a mixture of phonetic training and visual feedback. The first two training conditions resulted in virtually the same degree of improvement². The group that received both phonetic training and visual feedback, however, showed no improvement when compared to the control group. This last group did however, have the most variation in its results, which suggests that the mixed training worked very well for some participants, but almost not at all for others.

² Improvement was determined by the degree of discriminability between the two categories

1.4 The aim of this study

The goal of this project is to determine if there is evidence that an approach to pronunciation pedagogy rooted in articulatory phonetics can lead to an improvement in the production of target sounds, using a method that is realistic for an everyday classroom setting. “Realistic” refers to something that, if given the proper training, teachers would be able to replicate in their classrooms — unlike ultrasound which, again, has been shown to be effective, but isn’t something that is feasible for the average language classroom.

The end goal is to show that teaching this way can, in fact, improve someone’s pronunciation, but we must first determine whether or not articulatory instruction can at all make a difference in the production of target sounds. Once this is established, we can then ask if that difference would result in vowel production that is any more similar to that of native French speakers.

An ideal approach was considered to be one that addressed common errors made by those learning French as a second language while also requiring participants to change only one aspect of their vowel production at a time. The latter factor was desired so as not to overwhelm participants and thereby reduce the chances of seeing any considerable changes. Given these guidelines, the two French mid vowels [e] and [ø] were chosen. In American English, [e] is only seen in the diphthong [eɪ] and does not occur on its own. Subsequently, American English speakers have a tendency to diphthongize the French [e], with an increasing F2 and a decreasing F1, resulting in a pronunciation similar (if not identical) to [eɪ]. The single focus of the training for [e] was a reduction in diphthongization, using [eɪ] as a point of reference. Due to the fact that all rounded vowels in American English are back vowels, [ø] is often realized as something closer to [u] or [o] by speakers of American English. The focus of the training for [ø] was to build on the foundation of [e] by producing the vowel they had already learned, this time with rounded lips.

2. Methods

2.1 Participants

The participants were eight (6F, 2M) New York University students ranging from 18 to 21 years of age — all native speakers of American English. At the time of the recording, all were taking at least one class conducted in French, and all had been living in Paris for at least three months. The level of the participants' French varied: K and M were at the elementary level; E³, L, and N were at the intermediate level; R, S, and Z were at the advanced level⁴. Participants were recruited from varying levels of French to test whether there was a correlation between French level and post-training improvement. It was hypothesized that more advanced speakers would show less improvement (even if their initial vowel production was similar to that of a less-experienced speaker). The reasoning was that advanced students would be more deeply rooted in their pre-training pronunciation of the vowel and therefore (on the basis of sheer habit) would require more sustained input to alter — and, ideally, improve — their production of the vowels.

2.2 Procedure

The procedure consisted of three phases: a pre-training recording, a training session, and a post-training recording. For both the pre-training and post-training recordings, participants read the same list of stimuli (shown in table 1) containing the target vowels [e] and [ø]. The stimuli were chosen with careful consideration of the potential effects of the surrounding segments. Glides, nasals, and approximants were avoided. These decisions were, however, based on the pronunciation of the words when produced by a native french speaker and may differ from how English speakers often

³ Participant E had prior exposure to phonetics in the context of singing lessons. No other participant had any prior exposure.

⁴ Levels are based solely on the classes the participants were taking at the time of the sessions and do not necessarily represent actual speaking ability or comfort level.

pronounce certain words, especially given the possible influence of French orthography. Additionally, the environment of [ø] was restricted to the ends of words, as most speakers of modern Parisian French (especially younger speakers) produce this vowel as [œ] in other positions. The environment of [e] is less restricted; [e] appeared word-initially, word-medially, and word-finally in the list of stimuli.

[e]	[ø]
manger	peu
étonner	deux
été	feu
avez	veut
stressé	vœu
réveille	affreux
décrété	chanceux
bébé	cheveux
cherchez	amoureux
acheté	poreux
bouger	dangereux
libéré	fiévreux
préparer	terreux
mélangez	
fée	
faché	

Table 1. List of stimuli read by participants in pre-training and post-training recordings

After the initial recording, a 30-45 minute articulatory training was conducted, followed by a second recording to judge the improvement (or lack thereof) of

participants' vowel production. The training consisted of explanations of the articulation of each vowel, relevant background information (which, for these particular vowels, was mostly related to the difference between monophthongs vs. diphthongs and rounding), and tips to help with French orthography.

2.3 Training — [e]

The English [eɪ] was used as a point of reference for the French [e]. The plan was to describe [e] as the first portion of [eɪ] and to base the production of [e] on “cutting off the end” of [eɪ]. The [e] section of the training began with an explanation of diphthongs versus monophthongs. Because of its more obvious movement, [aɪ] was used to first solidify the concept of a diphthong before attempting to identify and understand the shorter movement of [eɪ]. The participants were shown videos of mid-sagittal MRIs (from sail.sc.edu) of the production of [aɪ] and repeated the sound. They were encouraged to focus on feeling the movement of their tongues and, after they felt confident that they understood this concept, they then repeated this process with [eɪ]. The participants practiced saying the beginning of the word “hay,” stopping before they felt themselves move their tongue or jaw. This was followed by isolating the vowel and practicing (with feedback from the training instructor). After they felt comfortable producing [e] on its own, they practiced producing French words containing [e]. This was followed by a quick rundown of how [e] is represented in French orthography (shown in figure 1), followed by more practice.

Where do we see this vowel?

- Any time we have an “e” with an accent aigu → “ é ”
 - ◆ médecin, prévu, été
- At the end of a word, before a silent consonant (always with verbs ending in “er”)
 - ◆ imaginer, pompier, avez
 - ◆ but NOT when the last consonant is pronounced!
 - avgc, sept
- Practice!

Figure 1. Slide from the [e] portion of the training explaining how this vowel is typically represented in French orthography.

2.4 Training — [ø]

The overall structure of the second half of the training is very similar to that of the first half: relevant background information, explanation of the vowel at hand, orthography tips, and a great deal of practice. This portion of the training began with an explanation of (1) what rounding is and (2) that it can be controlled independently of other factors, namely, tongue position. The participants practiced producing [ø], based on the idea of repeating [e], but with rounded lips. They were provided with two possible approaches to producing [ø]: one starting with [e] and rounding the lips while attempting to keep the tongue at the front of the mouth, and another starting with an “o” mouth shape and keeping the lips in this position while thinking/saying [e]. The latter approach was preferable for most participants. Then, as with [e], they were given tips to help with French orthography (see figure 2), and practiced until he or she was comfortable producing the vowel on his or her own.

When do we see this vowel?

- How is this sound spelled?
 - ◆ Usually spelled as “eu” or “œu”
- This sound is mostly only seen at the ends of words, either when:
 - ◆ There is no consonant at the end of the word
 - peu, vœu, feu
 - ◆ Or there is a silent consonant (x, t, etc)
 - terreux, deux, veut
- In the middle of a word/when the final consonant is pronounced, the vowel is likely not “ø”
- Practice!

Figure 2. Slide from the [ø] portion of the training explaining how this vowel is typically represented in French orthography.

2.5 Data analysis

Sound files were analyzed using Praat. Formant measurements were taken at the midpoint and again at the 75% mark to look for reduction in the diphthongization of [e]. The Vowel Normalization and Plotting Suite (NORM) from the University of Oregon was used to create vowel charts for each speaker. The Bark Difference Metric, based on the formula developed by Syrdal and Gopal (1986), was used with the intention of “filtering out physiological differences while retaining sociolinguistic differences” between speakers (Thomas and Kendall 2015). Average values of native French speakers’ vowels were included in the charts for comparison.

Four characteristics were considered when analyzing differences between pre-training and post-training vowel production: placement, variability, diphthongization of [e], and duration. Variability is represented by the size of the ellipses on the charts (1 standard deviation) and diphthongization is represented by arrows. T-tests were used to determine whether a vowel’s F1 or F2 were significantly different for each individual

speaker. Additionally, the difference in duration was analyzed using t-tests for the entire group.

It was hypothesized that, post-training, there would be a smaller difference between the formants of [e] at the midpoint and at the 75% mark. This reduction in the diphthongization of [e] would result in a pronunciation that more closely resembles that of the native French speakers. As for [ø], it was hypothesized that F2 would increase post-training as a result of the participants' more forward tongue placement. Duration was expected to decrease post-training, principally as a result of the participants being more confident in their production of the vowels. These hypotheses were made on the premise that the training would indeed have an effect on the participants' vowel production, though this was not a guarantee.

3. Results

3.1 Elementary Speakers

Speaker M showed a significant difference in her F2 of [ø] ($p < 0.001$) and her post-training [e] was produced slightly lower than her pre-training [e]. As shown in Figure 3, her [ø] moved much farther forward, suggesting she succeeded in separating roundedness from backness and, as a result, the range of her F2 for [ø] almost completely overlaps with that of the native French speakers (though her range also extends further back). Neither the variation in her production for both vowels nor her diphthongization of [e] changed significantly.

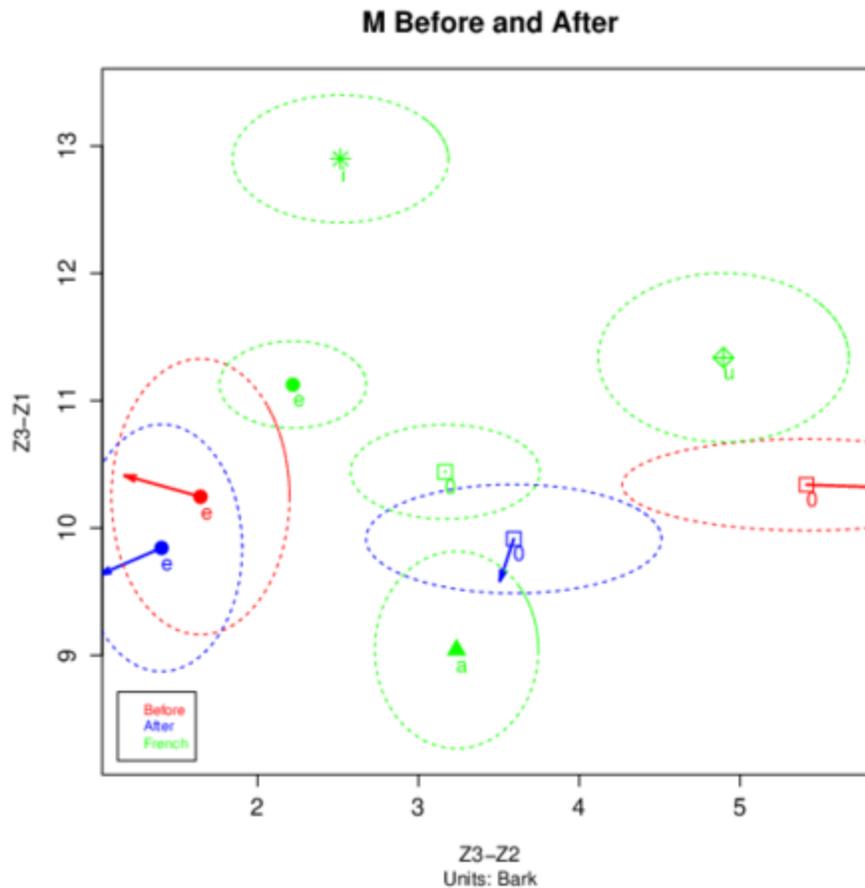


Figure 3. Speaker M’s pre-training and post-training vowel chart compared to that of average measurements from native French speakers. Pre-training vowels are shown in red, post-training vowels are shown in blue, and French speakers’ vowels are shown in green. [ø] is represented by “0.”

Speaker K’s post-training [ø] was produced farther back, while her post-training [e] was produced farther forward. Even though the training presents the two vowels as being produced with the same tongue position, she produced the two vowels farther apart after the training than she had before the training. The F2 of her [ø] was not only lower, its ellipse is also smaller post-training, meaning she was more consistently producing [ø] with her tongue farther back in her mouth. Her [e] showed little diphthongization both pre-training and post-training.

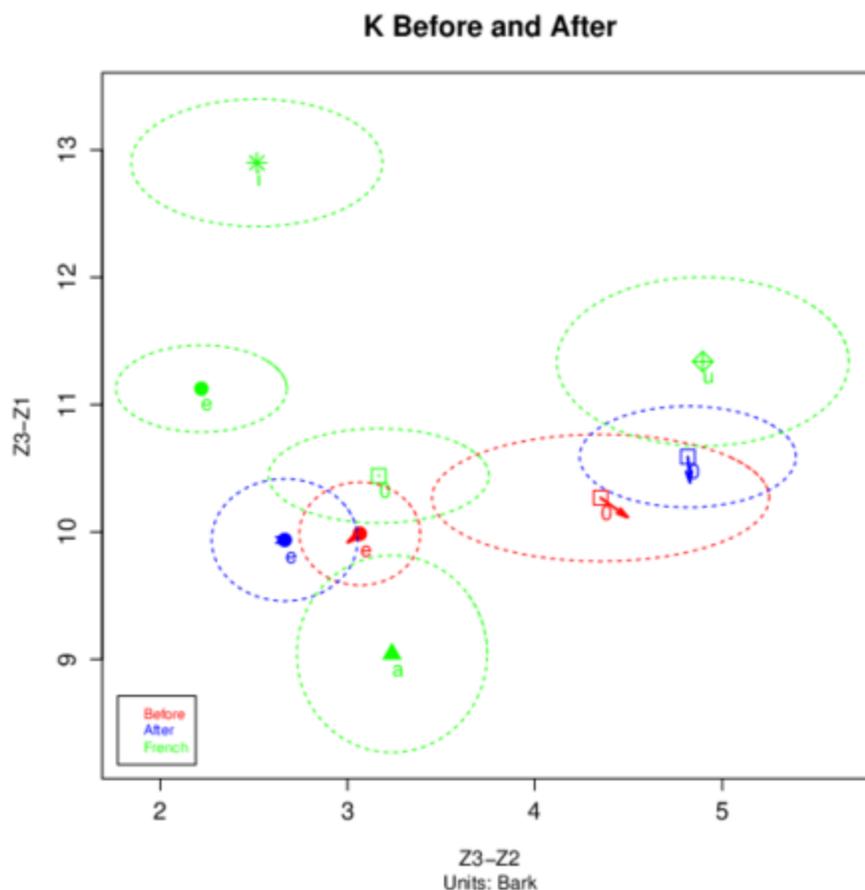


Figure 4. Speaker K’s pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

3.2 Intermediate Speakers

The F2 of speaker N’s [ø] showed a very large range before the training. This range overlapped with the native French speakers’ [ø], but it also extended very far back — past the range of the French speakers’ [u]. The range of both his F1 and F2 (for [ø]) post-training were almost entirely within the range of his pre-training [ø], but it was produced much farther forward, with much less variability. The range of his [e]’s F2 was extended forward, which could be an effect of his [ø] moving forward. There was no noticeable difference in the diphthongization of his [e].

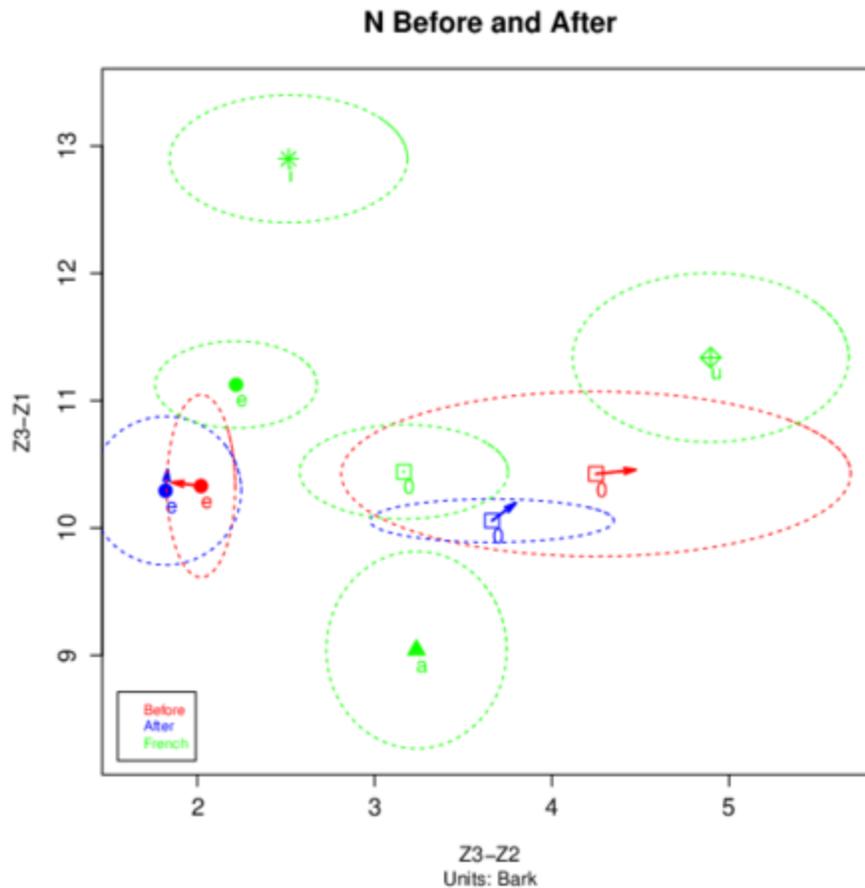


Figure 5. Speaker N's pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

Speaker L's [ø] was significantly farther forward post-training, and her [e] was slightly lower and slightly less variable. This downward movement could be an effect of trying to keep [e] and [ø] separate. As [ø] moves forward, [e] moves downward, perhaps to make more room and keep the vowels from overlapping. Speaker L did not show any change in the diphthongization of her [e].

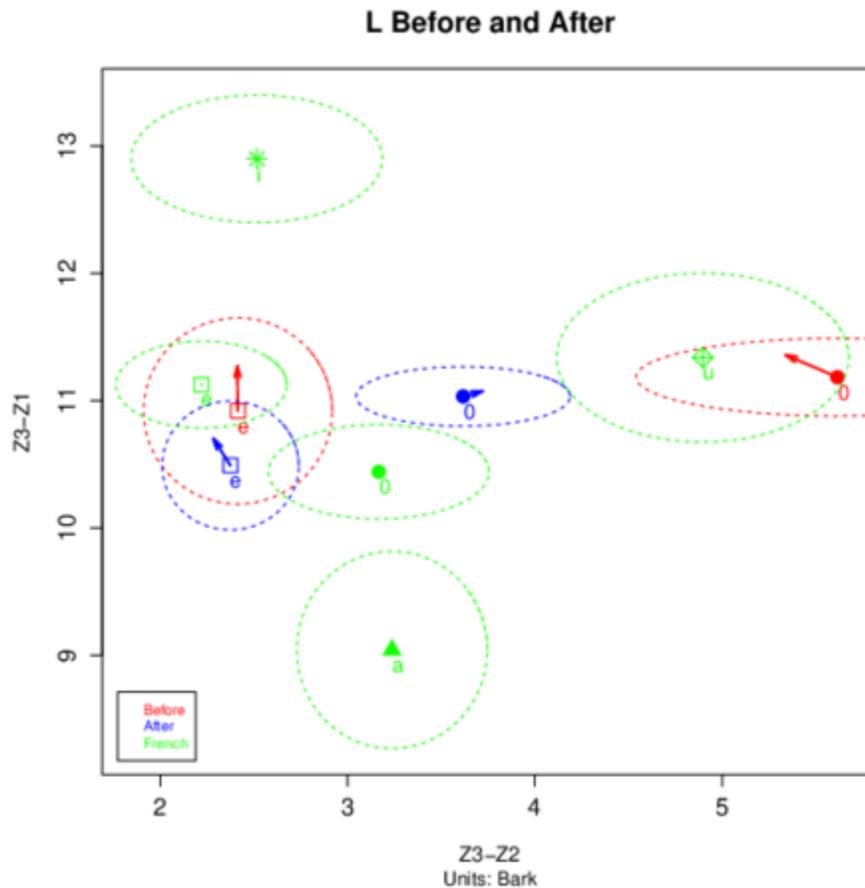


Figure 6. Speaker L’s pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

Speaker E’s results are similar to those of speaker L, in that her [ø] moved forward and her [e] was produced more consistently and lower post-training. However, even before the training, speaker E’s [e] was much lower than that of the native French speakers. The F2 of her pre-training [ø] overlaps with the back end of that of the native French speakers. After the training, her [ø] overlapped with the front end of the native French speakers’ [ø]. This forward movement is in line with the aim of the training, but given her initial placement of [ø], the F2 of her post-training [ø] does not necessarily seem to be any “better” than that of her pre-training [ø]. The range of her [ø] did extend

slightly upward, creating more overlap with the French speakers' [ø]. She did not show any improvement in the diphthongization of her [e].

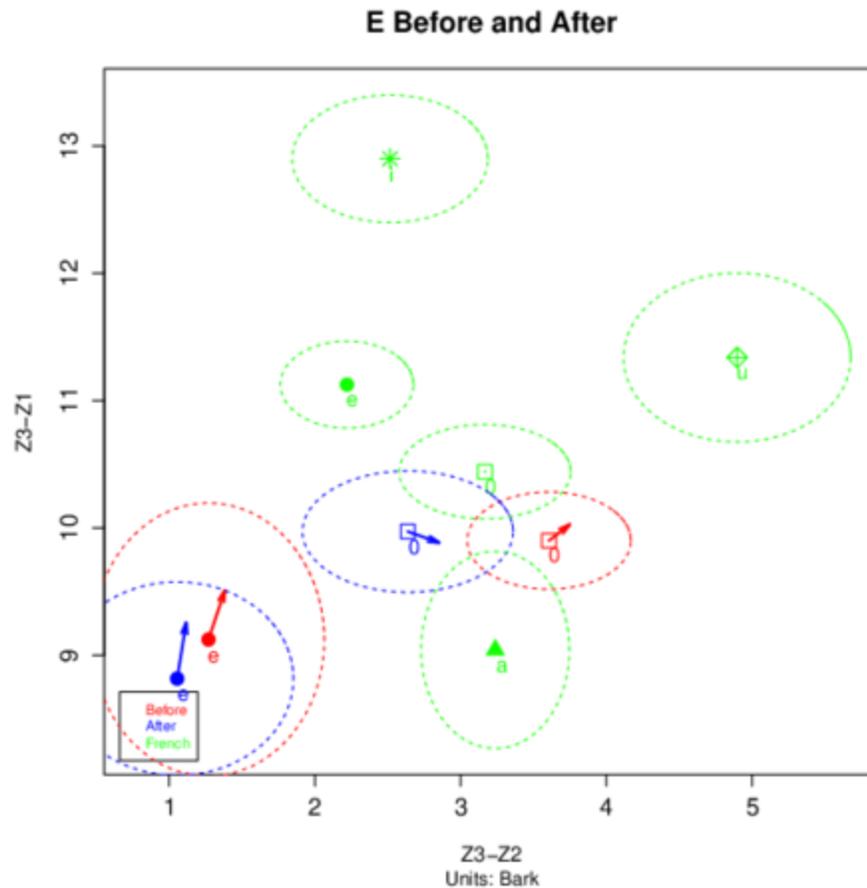


Figure 7. Speaker E's pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

3.3 Advanced Speakers

Speaker Z's post-training [ø] was higher and farther forward and her post-training [e] was slightly higher. Both vowels moved closer (either along F1 or F2) to the native French speakers' vowels. Her [e] was slightly less diphthongal post-training, though it is hard to tell if this is a significant difference. Neither of the vowels were produced with considerably more or less variability after the training.

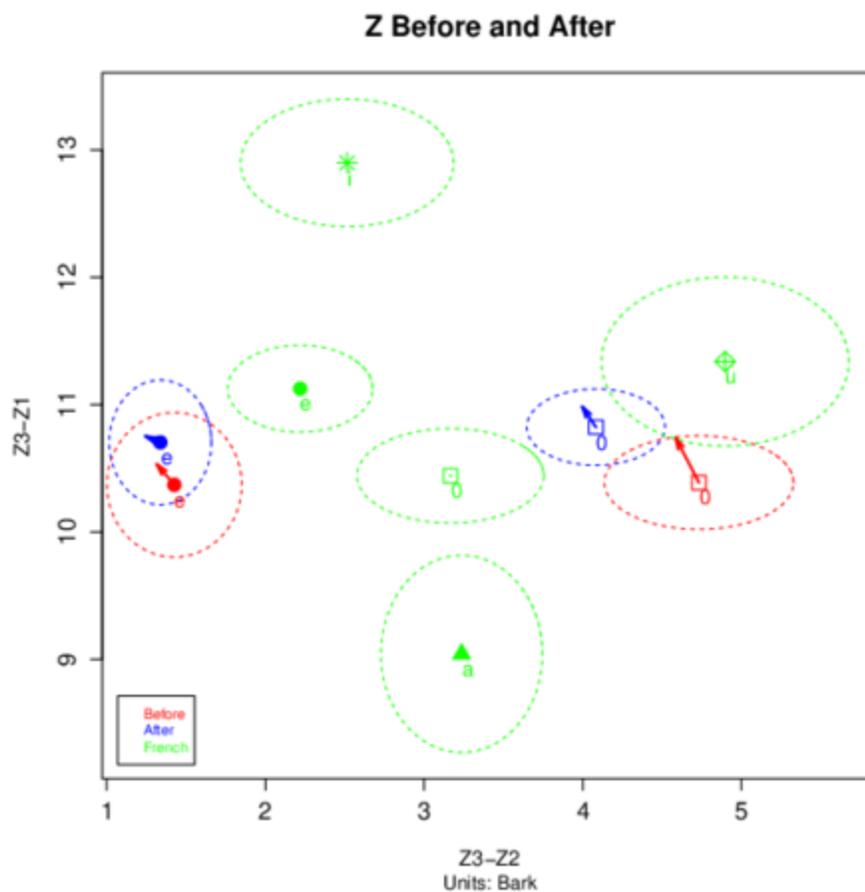


Figure 8. Speaker Z's pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

Speaker S showed the smallest difference between her pre-training and post-training vowels, with the only difference being a slight raising and backing of [ø]. The raising moves the vowel closer to that of the native French speakers, but the backing is not an expected or a desired result. There was no change in the diphthongization of her [e].

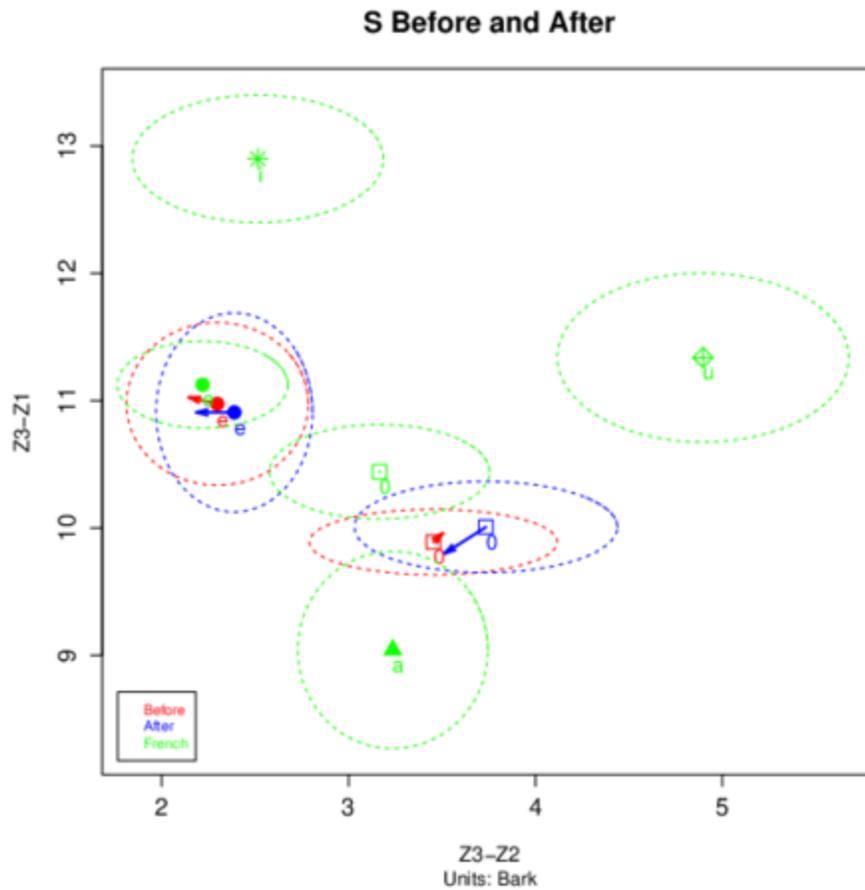


Figure 9. Speaker S's pre-training and post-training vowel chart compared to that of average measurements from native French speakers.

Speaker R's [e] is higher post-training, moving more closely to the native French speakers' [e]. His [ø] was produced with much less variability after the training, but it did not show any significant movement in any direction. There was no change in the diphthongization of his [e].

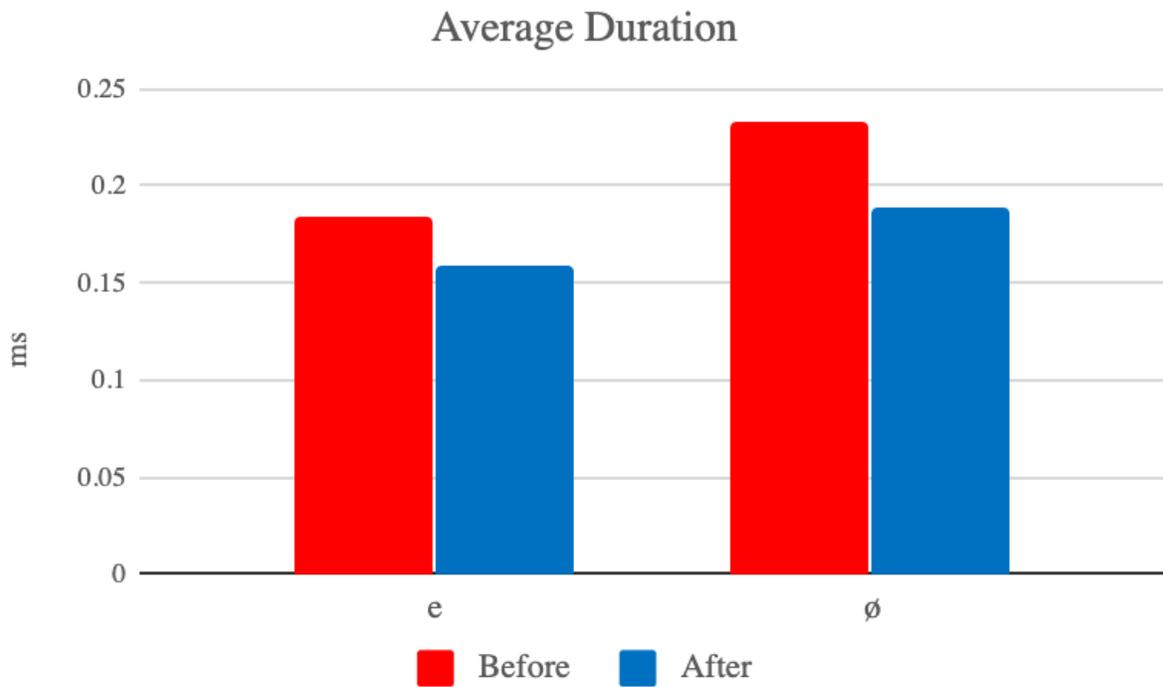


Figure 11. Average pre-training and post-training duration of [e] and [ø] for all speakers.

However, not every speaker showed an improvement in the duration of their vowels. As shown in figures 12 and 13, the duration of [e] decreased for 6 out of 8 speakers and the duration of [ø] decreased for 7 out of 8 speakers. The duration of both vowels increased for speaker M.

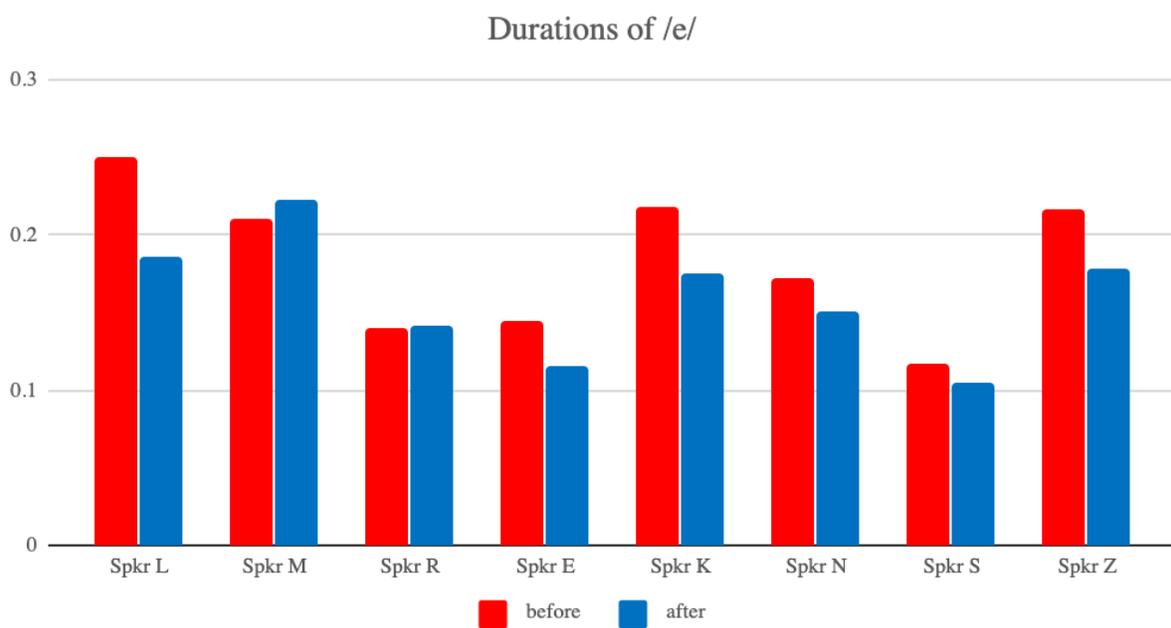


Figure 12. Average pre-training and post-training duration of [e] for individual speakers.

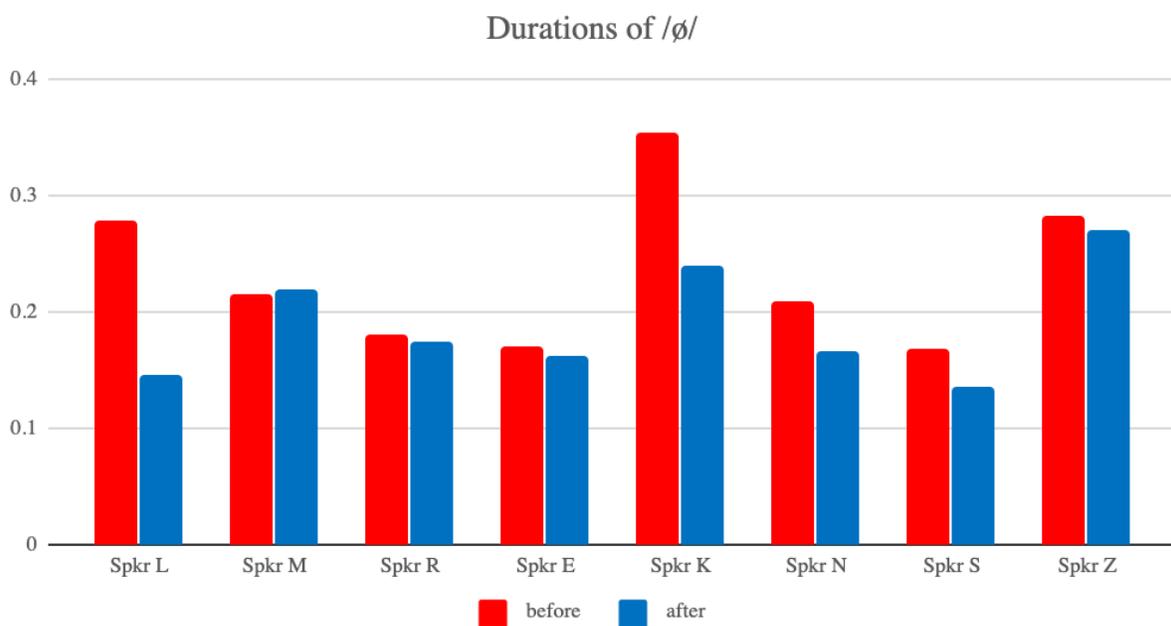


Figure 13. Average pre-training and post-training duration of [ø] for individual speakers.

3.5 Summary

The change that was the most consistent among the speakers was a more forward pronunciation of [ø]; this was observed for five out of eight speakers. Across all participants, [e] did not undergo as much change as [ø]. There were slight changes in F1 or F2 for some speakers, especially in the cases where [ø] moves forward and [e] moves to keep the two vowels distinct, but otherwise the pre-training and post-training ellipses of [e] more or less overlap for the majority of speakers.

The diphthongization of [e] seemed to be the characteristic that changed the least across the board. That being said, some speakers already had a fairly monophthongal pronunciation of [e] to begin with, so this lack of change should not necessarily be equated with a lack of improvement. The changes in the variability of production (of both vowels) were too varied to make generalizations.

As to whether or not a participant's level of French correlates with how much their vowel production was affected, overall, the less experienced speakers' [ø] showed more movement than that of the more advanced speakers. Speaker Z, however, unlike the other advanced speakers, did show significant forward movement of her [ø]. Speaker K (an elementary speaker) did not pattern as expected; her [ø] moved significantly farther back. Participant S (an advanced-level speaker) showed the least amount of change between her pre and post-training vowels. Additionally, every participant showed some sort of difference (even if it was small or undesired), not solely those who had less experience with the language.

4. Discussion

Though the diphthongization of [e] did not show the desired outcome, the duration of both vowels and the placement of [ø] changed significantly for most speakers. It was hypothesized that both vowels would shorten post-training, which was the case for 6 out of 8 speakers. Speaker R only showed a decrease in the duration of [ø] and speaker M

showed an increase in duration for both vowels. 5 out of 8 speakers showed an improvement in the placement of their [ø]. Of the three who did not, two were advanced speakers (speakers S and R) and one was an outlier whose [ø] was backed (speaker K).

Those who brought their [ø] forward while also lowering their [e] could be doing so as a way of ensuring the two sounds stay distinct. As [ø] moves forward, [e] moves downward for some speakers to make more room and keep the two vowels separate, indicating that the training didn't just cause them to push one vowel forward, it led to a shift in the participants' vowel chart (even if only temporarily).

Given that all of the participants are native speakers of American English, they already had a place for [e] in their vowel space. The category of front rounded vowels, however, does not exist in American English, therefore it is logical that [ø] was more affected by the training session than [e].

There was no one feature that showed the same change for every speaker and not every speaker's vowels showed significant differences post-training, but it is clear that this kind of instruction can make a difference and, in many cases, lead to an improvement in production of target sounds.

Perhaps refining the training could lead to more consistent results — possibly by reviewing the information with the participants on multiple occasions over a longer period of time, thereby giving them more time to fully grasp the concepts and to practice producing the vowels. At the end of the day, more consistent effects might just require more practice and, therefore, more time. Such a setting would also more accurately mirror the everyday environment of L2 classrooms, better lending itself to any future applications.

Future work could consist of a follow-up study in which native French speakers judge whether or not the non-native speakers' recordings sound "better" pre-training or post-training. Similar methods have been used to study native speakers' perception and judgment of non-native accents and have shown that most native speakers' judgments

show correlations between accentedness and errors, intelligibility, comprehensibility, etc. (Derwing & Munro, 1995). It can be hypothesized that, given their relatively accurate intuitions, native speakers would then be able to detect whether a recording of non-native speech was “more French” or “less French” than another and that these judgments would align with post-training and pre-training recordings, respectively. Doing so would move beyond acoustic analysis and would provide information on how listeners perceive these changes, if at all.

5. Conclusion

This study tested whether or not explicit articulatory instruction can cause any noticeable changes in American English speakers’ production of French vowels and, if so, whether or not it can help these speakers produce target sounds more similarly to native French speakers. The phonetic training used in this study proved to have a significant effect on most speakers’ production of one or both vowels. Furthermore, although the training did not help speakers reduce their diphthongization of [e], it was very effective in shortening the length of participants’ vowels and in correcting the common error of backing the front rounded vowel [ø]. This type of explicit articulatory instruction has the potential to be a useful method for teaching pronunciation that would be feasible for the everyday L2 teacher, if given the proper training.

6. Acknowledgements

I would like to thank my advisor, Lisa Davidson, for her help and expertise throughout the process of this project. I would like to thank the New York University Department of Linguistics for giving me the opportunity to pursue this research. Lastly, I would like to thank the New York University Dean’s Undergraduate Research Fund for funding this project.

References

- Baker, A., Perreault, D., Reid, A., & Blanchard, C. M. (2013). Feedback and organizations: Feedback is good, feedback-friendly culture is better. *Canadian Psychology/Psychologie canadienne*, 54(4), 260–268. <https://doi.org/10.1037/a0034691>
- Brinton, D. M. (2018). Teacher Preparation for Teaching Pronunciation. *The TESOL Encyclopedia of English Language Teaching*, 1–7. doi: 10.1002/9781118784235.eelt0243
- Cathcart, R. & Olsen, J. (1976). Teachers' and students' preferences for correction of classroom conversation errors. In J. Fanselow & R. Crymes (Eds.). *On TESOL '76*. Washington, DC: TESOL.
- Derwing, T. M., & Munro, M. J. (2005). Second Language Accent and Pronunciation Teaching: A Research-Based Approach. *TESOL Quarterly*, 39(3), 379. doi: 10.2307/3588486
- Lee, J., Jang, J., & Plonsky, L. (2014). The effectiveness of second language pronunciation instruction: A meta-analysis. *Applied Linguistics*, 36, 345–366.
- Levis, J.M., Sonsaat, S., Link, S. and Barriuso, T.A. (2016), Native and Nonnative Teachers of L2 Pronunciation: Effects on Learner Performance. *TESOL Q*, 50: 894-931. doi:10.1002/tesq.272
- Lin, S., Cychosz, M., Shen, A., & Cibelli, E. (2019). The Effects of Phonetic Training and Visual Feedback on Novel Contrast Production. Retrieved from https://icphs2019.org/icphs2019-fullpapers/pdf/full-paper_475.pdf
- Lyster, R., & Saito, K. (2010). Oral Feedback In Classroom Sla. *Studies in Second Language Acquisition*, 32(2), 265–302. doi: 10.1017/s0272263109990520

Munro, M.J. and Derwing, T.M. (1995), Foreign Accent, Comprehensibility, and Intelligibility in the Speech of Second Language Learners. *Language Learning*, 45: 73-97. doi:10.1111/j.1467-1770.1995.tb00963.x

Saito, K. (2012). Effects of instruction on L2 pronunciation development: A synthesis of 15 quasi-experimental intervention studies. *TESOL Quarterly*, 46, 842-854. doi:10.1002/tesq.67

Speech Production and Articulation Knowledge Group, & University of Southern California. (n.d.). the real-time MRI IPA charts. Retrieved from https://sail.usc.edu/span/rtmri_ipa/index.html.

Syrdal, A.K., & Gopal, H.S. (1986). A perceptual model of vowel recognition based on the auditory representation of American English vowels. *The Journal of the Acoustical Society of America*, 79 4, 1086-100 .

Thomas, Erik R. and Kendall, Tyler. 2007. NORM: The vowel normalization and plotting suite.

Wilson, Ian and Bryan Gick. 2006. Ultrasound Technology and Second Language Acquisition Research. In *Proceedings of the 8th Generative Approaches to Second Language Acquisition Conference (GASLA 2006)*, ed. Mary Grantham O'Brien, Christine Shea, and John Archibald, 148-152. Somerville, MA: Cascadilla Proceedings Project.