Perceiving and learning downstress

July 11, 2024

Simon LiVolsi
Meghan Clayards

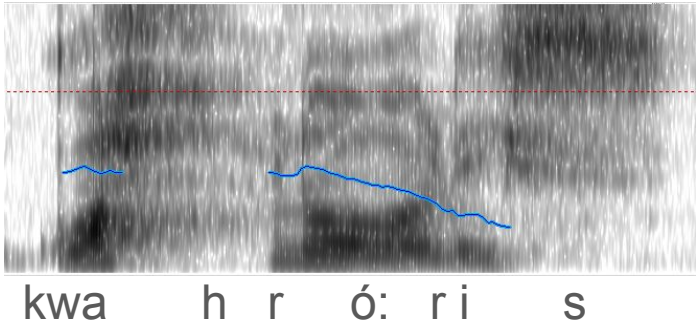
Introduction

- Kanien’kéha has traditionally been described as a ‘pitch accent’ language in which there are two types of stress accents (Pentangelo 2020)
  - Upstress: characterized by higher pitch — khahseróthaʼ ‘I’m turning on the light’
  - Downstress: characterized by a fall in pitch — kstathà:thaʼ ‘I make it dry’
- These can be hard to distinguish between for learners of Kanien’kéha
- This study presents experimental data on how English speakers can more efficiently learn downstress
- Findings:
  1. All participants improved in being able to identify downstress merely by taking part in the study
  2. Participants were more accurately able to identify downstress/upstress when trained with audio *and* visual stimuli than just with audio stimuli

Accent/stress in Kanien’kéha

- Stress is on the penultimate syllable
  - It may be realized as upstress or downstress (Michelson 1988)
- Tonic lengthening: Stressed vowels followed by only one consonant are lengthened
- Upstress (marked with an acute accent)
  - Traditionally described as ‘high tone’ (Michelson 1973, Julian 2010)
  - More recent fieldwork (including my own), however, has not found pitch to be a reliable cue (Renard 2023) - length and amplitude seem to be more consistent cues
  - Upstressed vowels may be short or long

kwahró:ris ‘I tell you (pl)’



Accent/stress in Kanien’kéha

- Downstress (marked with a grave accent)
  - When a stressed syllable is underlyingly closed by a glottal stop or /h/ (followed by a sonorant), the laryngeal deletes, the vowel is lengthened, and the vowel takes the pitch shape HL
    - CVHCV → CV́HCV → CV́CV → CV́:CV → CV̀:CV
  - Downstress is most often* realized as a small rise in pitch, followed by a steep fall
  - Note that downstress must occur on a long vowel, whereas upstress does not



Why is pitch accent hard for English speakers?

- Much of the literature on learning tone and pitch accent find that, when learning pitch contrasts, English speakers are *paying attention to different acoustic cues* (Bradley 2013)
  - Many studies have found that English speakers pay more attention to tone height when learning tones whereas tonal language speakers pay more attention to direction and slope of the tone (e.g. Gandour 1983, Jongman et al. 2017, Govind et al. 2011, Kimball and Cole 2016)
  - The main differences* between upstress and downstress in Kanien'kéha seem to be slope and direction
- Additionally, English speakers seem to be better at identifying LH than HL (the opposite of what is in Kanien'kéha) (Jongman et al. 2017)

How can learners be supported in learning downstress?

Some helpful strategies reported in the literature:

- Using explicit feedback is more effective than implicit feedback for beginners, but the opposite is true for more advanced learners (Li 2014)
- Comparing one's own visible pitch contour and with that of an L1 learner is helpful for learning tone (Hardison 2004 and Weltens & Bot 1984)
- Teaching with variability in the stimulus has been shown to aid in learning tone (Lively et al. 1993, Iverson et al. 2005, Wang et al. 1999)

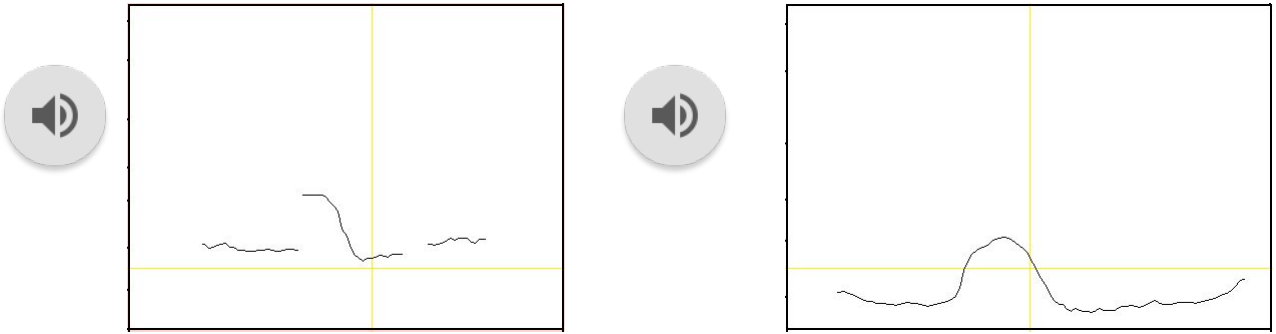
How can learners be supported in learning downstress?

Using visuals has been a widely reported successful strategy in learning tone

- Wiener et al. (2020) and Morett et al. (2022) have shown that using illustrative graphics of pitch contours to teach tone is effective
- Other studies have tested this theory and shown that visualizing the pitch contour of a specific tone (as opposed to just an idealized graphic) can be helpful in learning tone (e.g. Levis & Pickering 2004, Chun et al. 2013, Godfried et al. 2017)
- Liu et al. (2011) found that presenting learners of Mandarin with pictures of pitch contours improved perception of tone
- Wang et al. (2003) found that training people to perceive tone helps learners produce tone better

Experiment

- High Variability Phonetic Training: This experiment involves stimuli that vary phonetically and acoustically (which has been shown to aid in learning tone)
  - Audio stimuli will vary
  - Visual stimuli will vary (L: ietìka; R: iasèni)



- Does visualizing the pitch contour help learners learn tone?

Experiment: Methods

Pretest

- Participants' ability to distinguish between upstress and downstress was assessed

Training

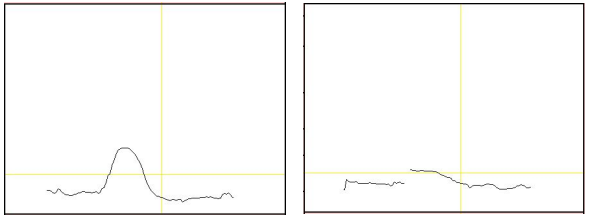
- Participants were given many examples with labels of downstress and upstress.
  - Half of the participants were additionally shown a picture of the pitch contour in the training

Posttest

- The ability to perceive downstress and upstress was evaluated to see whether participants learned, and if so, which group learned better

Experiment: Methods

- The experiment was designed with Gorilla
- 20 participants were recruited through the online recruitment software Prolific
  - All were monolingual English speakers from Canada or the United States
  - All participants were from 18-32
- Stimuli were nonce words following Kanien’kéha phonotactics
  - Form: CVCVCV
  - Nonce words as to more easily control for relevant factors
  - All have penultimate stress; Half with downstress, half with upstress
  - Half of the forms have a sonorant in C3 position, while the other half have obstruents in C3
  - Examples: nazòwi vs. nadége
- All forms were recorded by a highly proficient L2 speaker of Kanien’kéha, who teaches the language at McGill University
- The graphics were generated using praat (L: nazòwi; R: nidóya)



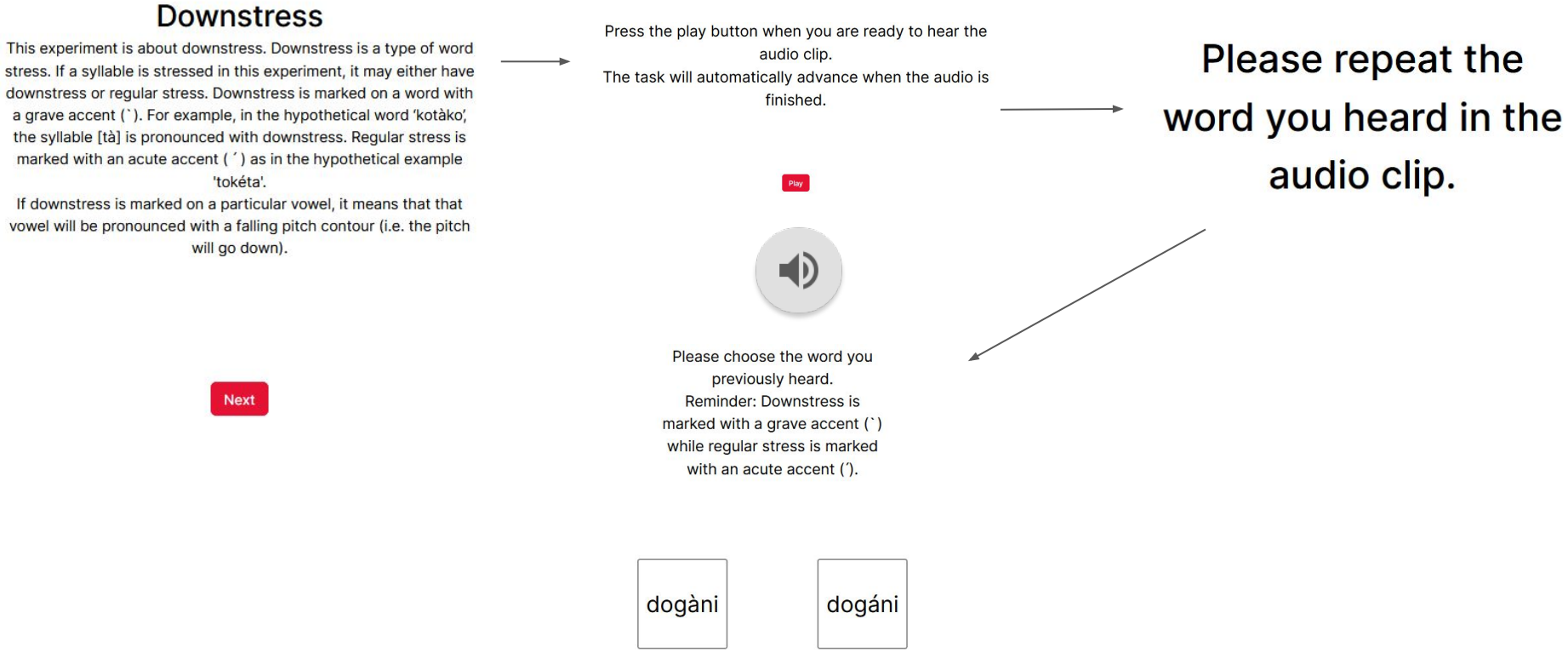
Experiment: Methods

Pretest

- Before the trials, participants are informed on what downstress is and how it is marked
- 20 trials (half of which involve downstress, and half of which involve a sonorant in C3)
- In each trial:
  - Participants hear a word that may or may not have downstress
  - Participants are asked to repeat the word
  - In a forced choice, Participants are asked to choose whether they heard a form with downstress or upstress

Experiment: Methods

Pretest



Experiment: Methods

After the pretest, participants were randomly divided into two groups

- Group 1: Normal training (just audio)
- Group 2: Graphic training (audio and visual)

Training

- Before trials, participants were reminded about what downstress is
  - Group 2 was given a description of what the pitch contour pictures will convey
- 40 trials
- In each trial:
  - Participants hear the audio of the stimulus (in the graphic training they are also presented with the pitch contour picture) while seeing the written form (fake orthography)
  - Participants were asked to repeat the word

Experiment: Methods

This step is only for Group 2

Section 2: Downstress training

In this section, you will practice perceiving and producing downstress.
You will first be presented with a written word. Then you will be presented with an audio clip showing how to pronounce this word.
You must listen to the audio carefully.
You then will be recorded saying this word.
You will have 5 seconds to repeat the word. After 5 seconds you will advance to the next screen.

Press Enter when you are ready to start!

Reminder about Downstress

This experiment is about downstress. Downstress is a type of word stress. If a syllable is stressed in this experiment, it may either have downstress or regular stress. Downstress is marked on a word with a grave accent (`). For example, in the hypothetical word 'kotàko', the syllable [tà] is pronounced with downstress. Regular stress is marked with an acute accent (´) as in the hypothetical example 'tokéta'.
If downstress is marked on a particular vowel, it means that that vowel will be pronounced with a falling pitch contour (i.e. the pitch will go down).
Please note that the pitch will fall slightly in regularly stressed syllables as well, it will just not be as dramatic a fall as in downstress. The stressed syllable will always be the second syllable.

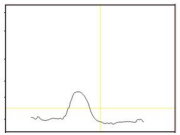
Next

Pictures of downstress

In this section, you will have a picture of the pitch contour associated with the written word that you will hear. This will be indicated by a line rising and falling in accordance to the pitch in the word. Please note that:
(1) Sometimes the pitch contour line will be broken up. Usually this is connected to where the syllables are. All lines that you will see are relevant to the pitch contour, so it will be helpful to imagine what the slopes/contours would look like if the lines were connected.
(2) Regular stress may also look like the pitch is falling, however it will not be falling as dramatically.
(3) As the stressed syllable is always the second syllable, expect to see the pitch contour falling especially in this syllable (near the middle of the word).

Next

Press the play button when you are ready to hear the audio clip.
The task will automatically advance when the audio is finished.



nazòwi

Play

Please repeat the word you heard in the audio clip.

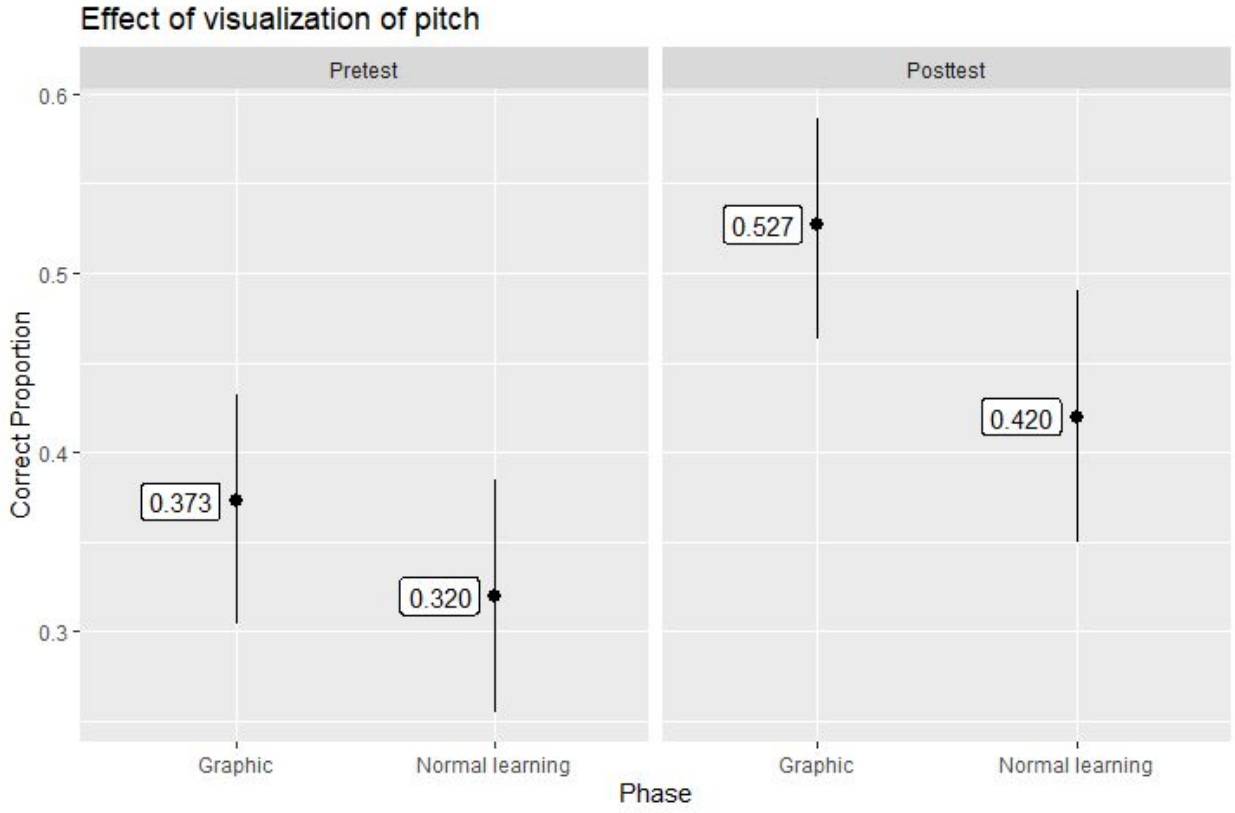
Experiment: Methods

- After the training phase, participants did the posttest
- The posttest is identical to the pretest, but involves a different ordering of the trials

- The experiment, on average, took around 20 minutes

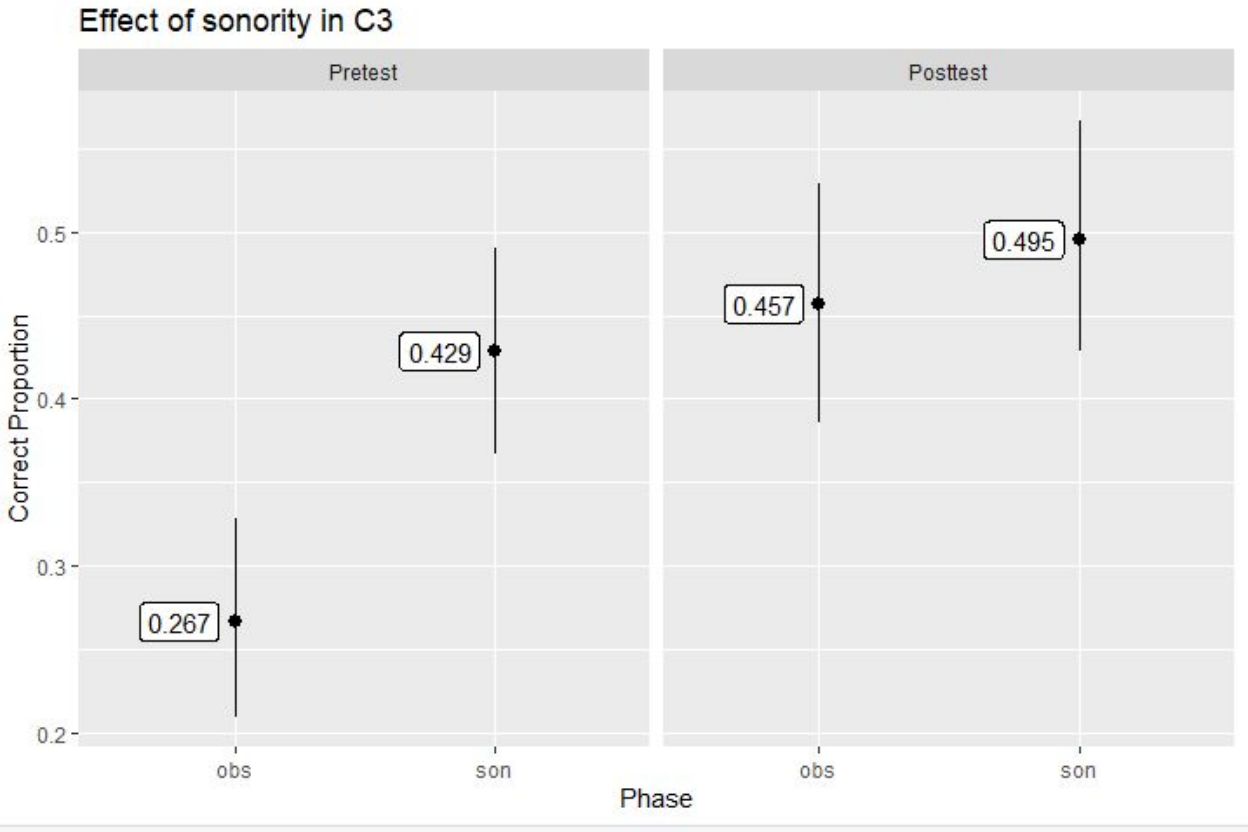
Experiment: Results

Graph 1



Experiment: Results

Graph 2



Experiment: Results

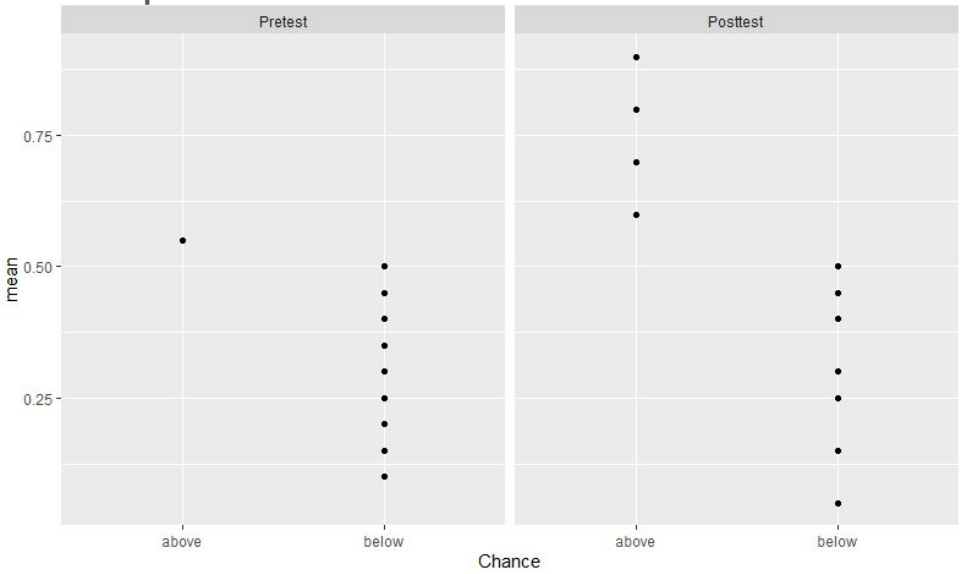
- But these results show participants starting *below chance* and as the experiment goes on, participants get closer to chance
- At the end of the pretest, then, it seems like participants were already pretty accurate at distinguishing between downstress, they were just clicking upstress when they were supposed to choose downstress
- At the end of the posttest, the participants were seemingly worse at distinguishing between downstress and upstress

Experiment: Results

We can explain the previous results by looking at individuals

- In graph 3, we can see that the chance results in the posttest are merely reflecting the fact that some participants test above chance, and some below chance (i.e. different participants are patterning differently)

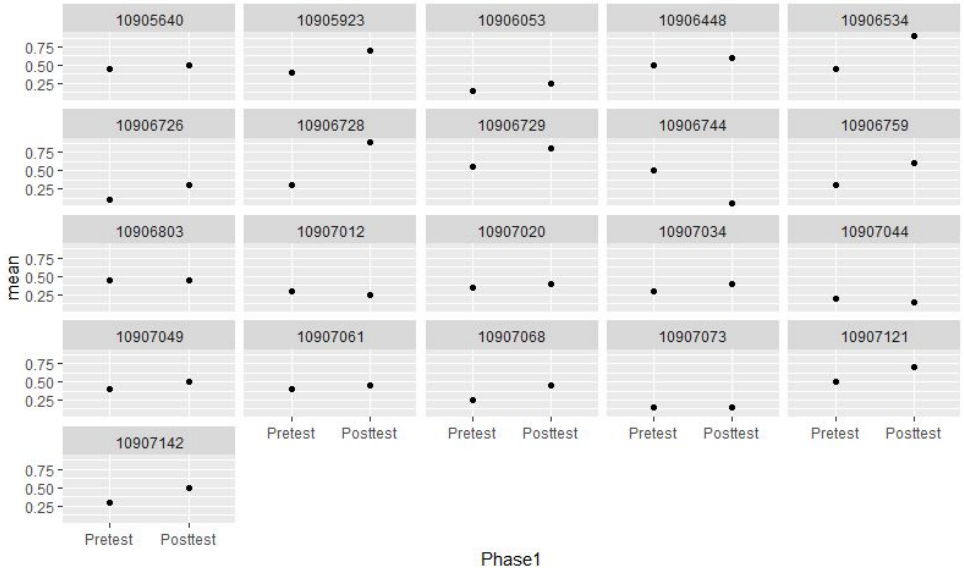
Graph 3



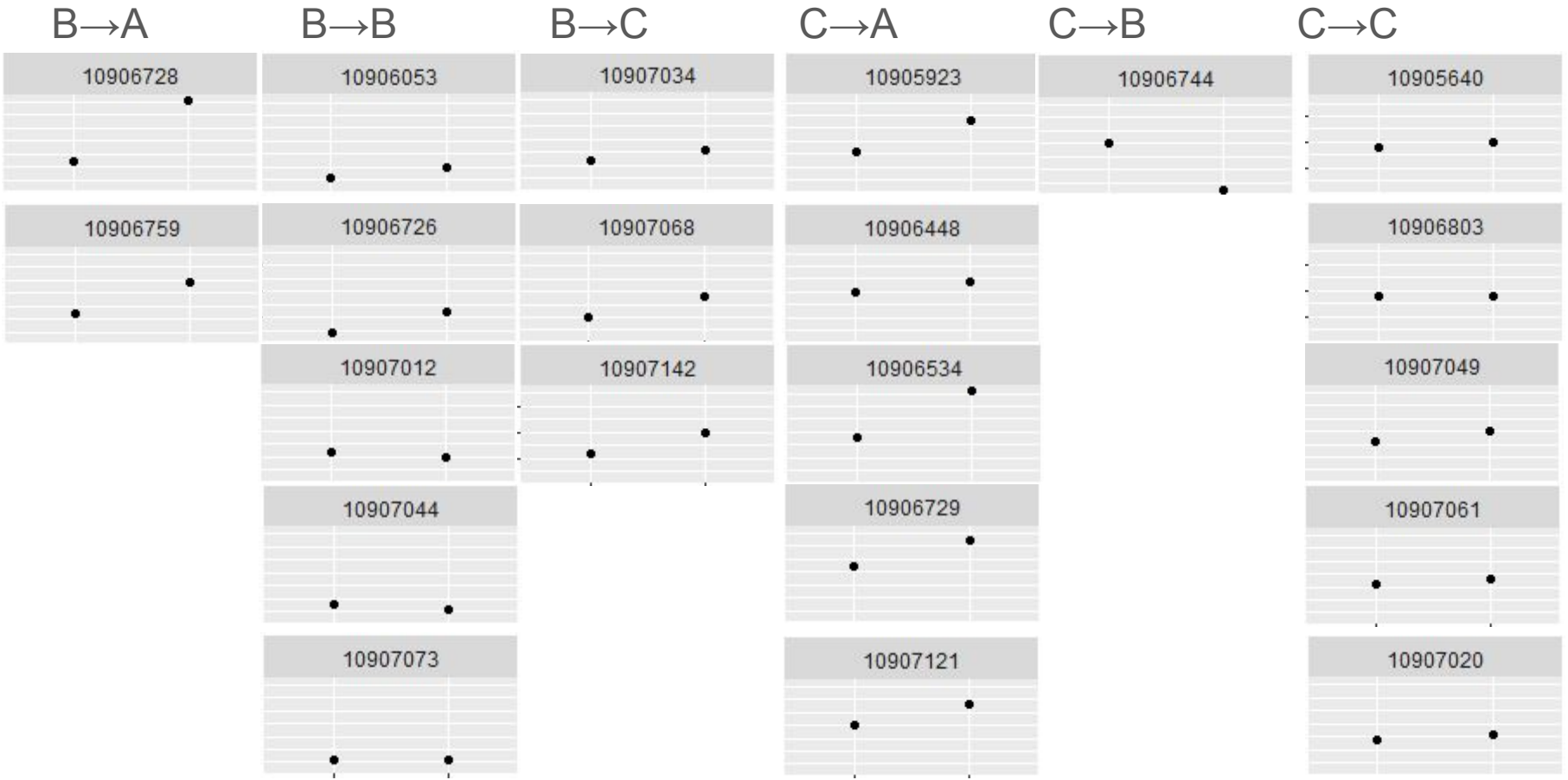
Experiment: Results

- Participants do not seem to be following a single trend
- However, most participants seemed to be learning to distinguish between upstress and downstress (just some with wrong labeling)

Graph 4

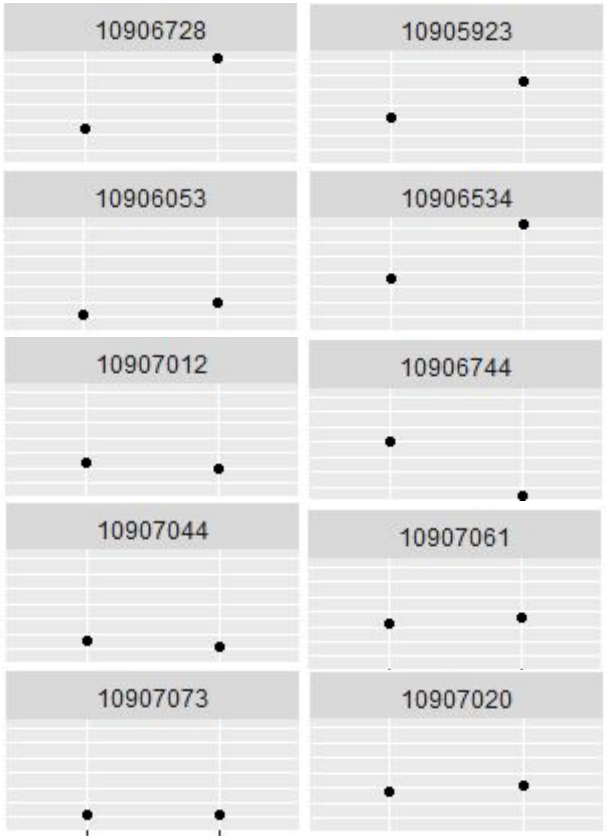


Experiment: Results

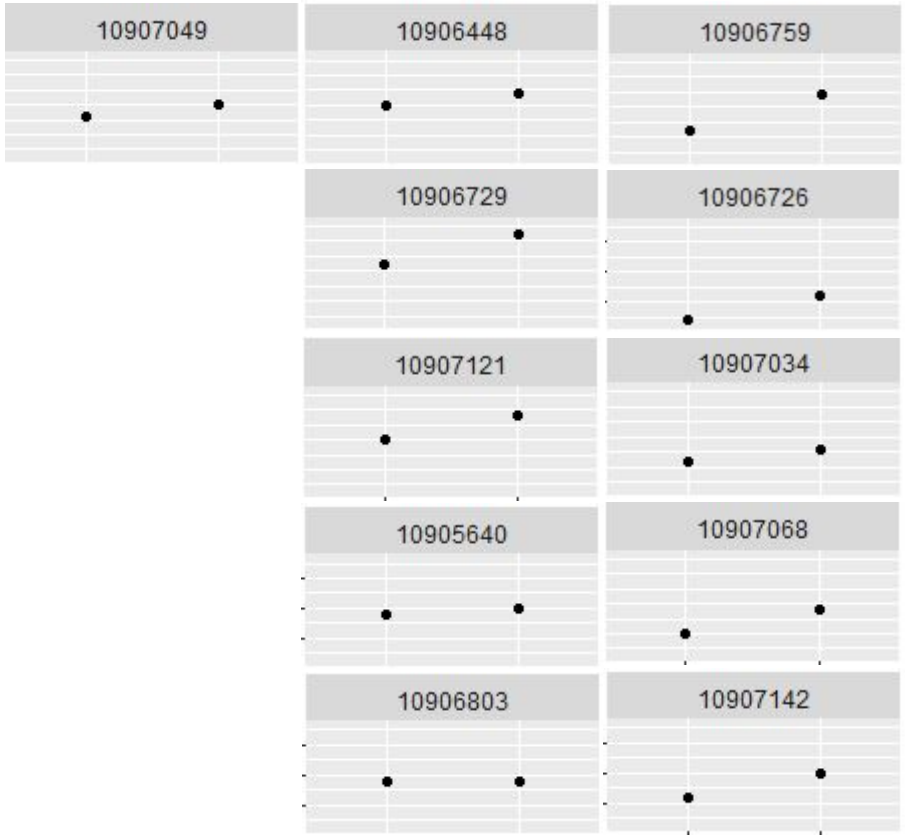


Experiment: Results

Normal



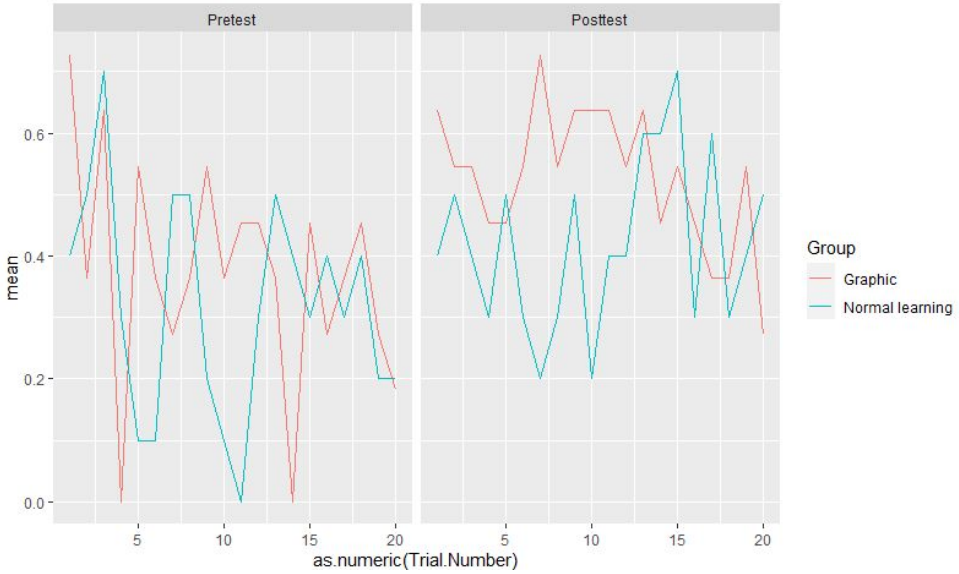
Graphic



Experiment: Results

- Graph 4 shows that participants learned during the test phases
- In the pretest, participants got better at distinguishing between upstress and downstress (just labeling them wrong)
- In the posttest, the graphic training group is more accurate at the beginning, but then gets closer to chance whereas the normal group stays around chance

Graph 5



Experiment: Results

Summary

- Participants learned over the course of the experiment
- Learning seems to go in one of two directions (although all participants seem to get better at distinguishing between downstress and upstress):
  - Some participants label downstress and upstress correctly, and thus are above chance
  - Some participants label downstress and upstress incorrectly, resulting in being below chance
  - This results in the overall results looking like participants are all at chance
- Unexpectedly, participants are better at identifying downstress (when completely unfamiliar with it) when followed by an obstruent
- Although the participants, on average, were at chance, the graphically trained group seemed to tend slightly more to the above chance than normal training

Experiment: Discussion

- Visuals seemed to help in correcting the label
  - Despite being told which are forms had downstress and which had upstress, participants did not learn this difference without the graphics
- Almost all participants seemed to improve in distinguishing between upstress and downstress
- Perceiving downstress is easier when it is before an obstruent?
  - Maybe because the speaker is forced to produce a steep fall in the HL, resulting in a stark contrast between upstress and downstress. When there is a following sonorant, the HL is less steep as it can bleed into the sonorant and thus becomes more similar to upstress
  - This pattern seems only to be the case when still unfamiliar with upstress and downstress

What next?

- Building materials modeled after this experiment
- YouTube videos of different types that can be used to improve learners' perception of downstress and upstress
  - Nonce words read by proficient L2 (as many teachers are L2)
  - Real words read by proficient L2
  - Nonce words read by L1
  - Real words read by L1
  - Visible pitch contours
- What do you all think would be helpful?

References

Bradley, E. 2013. Pitch perception in lexical tone and melody. Reviews of Research in Human Learning and Music, 1, 1–26.

Chun, D. M., Jiang, Y., & Ávila, N. (2013). Visualization of tone for learning Mandarin Chinese. In J. Levis & K. LeVelle (Eds.). Proceedings of the 4th Pronunciation in Second Language Learning and Teaching Conference. Aug. 2012. (pp. 77-89). Ames, IA: Iowa State University.

Gandour, J. 1983. Tone perception in far Eastern-Languages. Journal of Phonetics, 11, 149–175.

Godfroid, A., Lin, C. H., & Ryu, C. 2017. Hearing and seeing tone through color: An efficacy study of web-based, multimodal Chinese tone perception training. Language and learning, 67(4), 819–857.

Govind, D., Sarmah, P., & Prasanna, S. R. M. 2011. Role of pitch slope and duration in synthesized Mizo tones. 39-42. 10.21437/SpeechProsody.2012-13.

Hardison, D. M. 2004. Generalization of computer-assisted prosody training: Quantitative and qualitative findings. Language Learning & Technology, 8, 34-52.

Iverson, P., Hazan, V., & Bannister, K. 2005. Phonetic training with acoustic cue manipulations: A comparison of methods for teaching English /r/-/l/ to Japanese adults. The Journal of the Acoustical Society of America 118, 3267.

Jongman, A., Qin, Z., Zhang, J., & Sereno, J. A. 2017. Just noticeable differences for pitch direction, height, and slope for Mandarin and English listeners. J. Acoust. Soc. Am. 142.

Julian, C. 2010. A history of the Iroquoian languages. Winnipeg: University of Manitoba dissertation.

Kimball, A., & Cole, J. 2016. Pitch Contour Shape Matters in Memory. Proceedings of Speech Prosody.

Levis, J., & Pickering, L. 2004. Teaching intonation in discourse using speech visualization technology. System 32(4), 505-524.

Li, S. 2014. The interface between feedback type, L2 proficiency, and the nature of the linguistic target. Language Teaching Research, 18, 373–396.

Liu, Y., Wang, M., Perfetti, C. A., Brubaker, B., Wu, S., & MacWhinney, B. 2011. Learning a tonal language by attending to the tone: An in vivo experiment. Language Learning, 61(4), 1119–1141.

Lively, S. E., Logan, J. S., & Pisoni, D. B. 1993. Training Japanese listeners to identify English /r/ and /l/: II The role of phonetic environment and talker variability in learning new perceptual categories. The Journal of the Acoustical Society of America, 94, 1242–1255.

Martin, A. 2023. Tekawennahsonterónnion: Kanien'kéha Morphology. Kanien'kehá:ka Onkwawén:na Raotitióhkwa' Language; Cultural Center.

Michelson, G. 1973. Thousand words of Mohawk. University of Ottawa Press.

Michelson, K. 1988. A comparative study of Lake-Iroquoian accent. New York: Springer.

Morett, L. M., Feiler, J. B., & Getz, L. M. 2022. Elucidating the influences of embodiment and conceptual metaphor on lexical and non-speech tone learning. Cognition, 222, Article 105014.

Pentangelo, Joseph. 2020. Kanien'kéha (Mohawk) (United States and Canada) - Language Snapshot . Language Documentation and Description 19, 1-8.

Renard, Martin. 2023. A Phonetic Description of Kanyen'kéha (Western Dialect). Proceedings of the 25th Workshop on American Indigenous Languages.

Wang, Y., Spence, M. M., Jongman, A., & Sereno, J. A. 1999. Training American listeners to perceive mandarin tones. Journal of the Acoustical Society of America, 106, 3649–3658.

Wang, Y., Jongman, A., & Sereno, J. A. 2003. Acoustic and perceptual evaluation of Mandarin tone productions before and after perceptual training. Journal of Acoustical Society of America, 113, 1033–1043.

Weltens & Bot. 1984. The visualisation of pitch contours: Some aspects of its effectiveness in teaching foreign intonation. Speech Communication 3, 157-163.

Wiener, S., Chan, M. K., & Ito, K. 2020. Do explicit instruction and high variability phonetic training improve nonnative speakers' Mandarin tone productions? The Modern Language Journal, 104(1), 152–168.

Thank you!