# VOWEL SYSTEMS IN CONVERGENCE

CHELSEA SANKER CHELSEA.SANKER@YALE.EDU YALE UNIVERSITY

ISSP 2020, Paper 145

## Introduction

- At what level of the representation does convergence generalize?
- Convergence generalizes across words with the same sound and sounds with the same feature, at least for VOT across place (Nielsen 2011)
- Unclear if other features would generalize in the same way; data from vowels is more limited

**This Study**: A shadowing task tests how exposure to shifted F1 in one vowel quality (/ɛ/) influences F1 of other vowels

*Shifts are generalized to vowels that share a phonological feature realized in the domain of manipulation, i.e. F1 manipulation influences other vowels of the same height*

## Methodology

- 24 female native speakers of English
- Pre-task and post-task reading
  - Reading a set of monosyllabic words in randomized order before and after the task
  - 60 target words (15 exposure items with /ɛ/, 15 novel items with /ɛ/, and 10 test items each of /æ/, /ɪ/, and /ʌ/), and 60 filler items
  - F1 measured for each word before and after the shadowing task
- Shadowing task
  - Repeating after 15 acoustically manipulated words, each presented three times
  - All exposure items had the vowel /ɛ/: *best, bet, dead, debt, fed, guess, less, mess, met, net, pet, red, set, test, wet*
  - Two conditions: half of participants heard these words with a raised F1 in the /ɛ/ and half heard a lowered F1
  - The same base recordings used for manipulations in both conditions, so the F1 manipulation was the only difference

## Predictions and Possible Explanations

Several patterns might be expected, reflecting different underlying processes:

| **shared phonological features in the domain of manipulation (height)** | **shared acoustics in the domain of manipulation (F1)** | **contrast preservation** | **normalization to the speaker's vowel space** |
|---|---|---|---|
| Raised or lowered F1 in one vowel will similarly change other vowels matching in height (cf. Mitterer 2006; Maye, Aslin, & Tanenhaus 2008; Chladkova, Podlipsky, & Chionidou 2017) | Raised or lowered F1 in one vowel will similarly change other vowels with similar baseline F1 | Raised or lowered F1 in one vowel will similarly shift vowels that differ only in height | Raised or lowered F1 in one vowel will impact the entire vowel space, in all formants (Sjerps, McQueen, & Mitterer 2013; Watkins & Makin 1994) |

## Results

**Table 1**: Model for F1 change. *Intercept: Manipulation = lowered F1, Vowel = /ɛ/*

| | $\beta$ | SE | t-value | p-value |
|---|---|---|---|---|
| (Intercept) | -6.2 | 5.38 | -1.16 | 0.254 |
| Manip RaisedF1 | 20.3 | 7.47 | 2.71 | 0.0104* |
| Vowel /æ/ | -0.66 | 7.05 | -0.09 | 0.925 |
| Vowel /ɪ/ | 12.0 | 7.05 | 1.7 | 0.0905 |
| Vowel /ʌ/ | -4.0 | 7.05 | -0.57 | 0.571 |
| Manip RaisedF1*Vowel /æ/ | -6.35 | 9.53 | 2.71 | 0.505 |
| Manip RaisedF1*Vowel /ɪ/ | -23.5 | 9.53 | -2.46 | 0.014* |
| Manip RaisedF1*Vowel /ʌ/ | 6.41 | 9.53 | 0.67 | 0.501 |

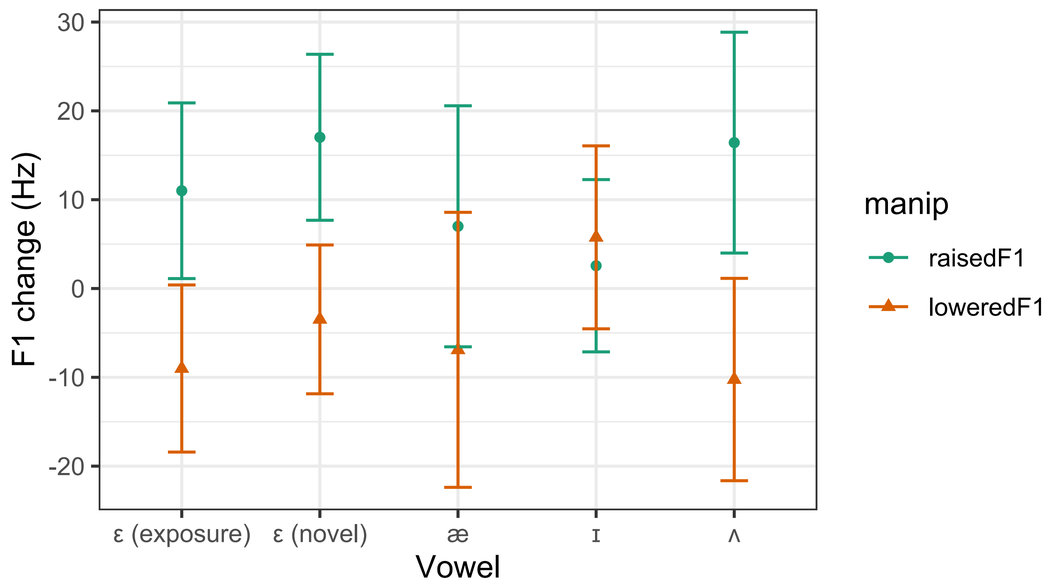


**Figure 1**: F1 change (posttest - pretest)

Participants' F1 increased after raised F1 exposure and decreased after lowered F1 exposure, but only for mid vowels
Same effect for exposure /ɛ/ items, novel /ɛ/ items, and also /ʌ/

## Conclusions

- **Feature-based convergence**: Convergence to one vowel is generalized to vowels with the same phonological representation or acoustic target in the domain of manipulation – manipulated F1 in /ɛ/ was extended to the other mid vowel, /ʌ/
- Because the F1 of these vowels is also similar (participants' mean baseline F1 was 790 Hz for /ɛ/ and 779 Hz for /ʌ/), the data doesn't clarify whether effects depend on shared phonological features or shared acoustic realizations
- **Not contrast preservation or normalization**: The results cannot be explained by category maintenance or normalization; F1 convergence was not extended to the high and low front vowels

## Selected References

Chládková, K., Podlipskỳ, V., & Chionidou, A. (2017). Perceptual adaptation of vowels generalizes across the phonology and does not require local context. *Journal of Experimental Psychology: Human Perception and Performance, 43*(2), 414–427.
Maye, J., Aslin, R., & Tanenhaus, M. (2008). The weckud wetch of the wast: Lexical adaptation to a novel accent. *Cognitive Science, 32*(3), 543–562.
Mitterer, H. (2006). Is vowel normalization independent of lexical processing?*Phonetica, 63*(4), 209–229.
Nielsen, K. (2011). Specificity and abstractness of VOT imitation. *Journal of Phonetics, 39*, 132-142.
Sjerps, M., McQueen, J., & Mitterer, H. (2013). Evidence for precategorical extrinsic vowel normalization. *Attention, Perception, & Psychophysics, 75*(3) 576–587.
Watkins, A., & Makin, S. (1994). Perceptual compensation for speaker differences and for spectral-envelope distortion. *Journal of the Acoustical Society of America, 96*(3), 1263–1282.