Phonological Inference and Adaptation to Cross-Category Vowel Mismatches

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Background & Motivation

Brief exposure to an unfamiliar accent improves word recognition via adaptive processes [1-3]. This line of research has tended to investigate adaptation to isolated within-category consonant variability [4,5], or to entire sound repertoires [1,3]. Less is known about how listeners adapt to and generalize learning about vowel variation [but see 6], despite the fact that dialects of some languages, including American English, are characterized predominantly by vowel variation [7].

Research Questions

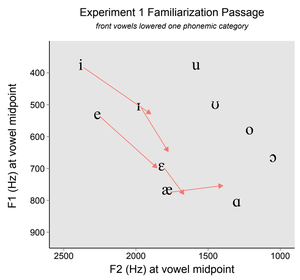
1. How do listeners cope with cross-category vowel variability in speech processing?
2. Does vowel adaptation generalize to new words and untrained vowel shifts?

Method

Task Overview

Modified *weckud wetch* paradigm [6]

1. Auditory lexical decision
2. Familiarization to novel accent (20 min.)
   - Exp1: cross-category **front** vowel lowering
   - Exp2: cross-category **back** vowel lowering
3. Auditory lexical decision



Structure of Auditory Lexical Decision Tasks

Novel Accent	LexDec Item Types	Example Item	# of Lexical Decision Items: Pre-familiarization	Post-familiarization
Exp 1 *front vowel lowering*	Standard Vowel		80	120 (pre- + 40 new)
	Front Vowel Lowered	*witch* as [wɪ̲tʃ], cf. /wɪtʃ/	40	60 (pre- + 20 new)
	Front Vowel Raised	*swift* as [swi̲ft], cf. /swɪft/	40	60 (pre- + 20 new)
	Front Vowel Backed	*drift* as [dru̲ft], cf. /drɪft/	40	60 (pre- + 20 new)
	TOTAL		**200**	**300**
Exp 2 *back vowel lowering*	Standard Vowel		80	120 (pre- + 40 new)
	Back Vowel Lowered	*wooden* as [wʊ̲dən], cf. /wʊdən/	40	60 (pre- + 20 new)
	Back Vowel Raised	*good* as [gu̲d], cf. /gʊd	40	60 (pre- + 20 new)
	Back Vowel Fronted	*shook* as [ʃu̲k], cf. /ʃʊk	40	60 (pre- + 20 new)
	TOTAL		**200**	**300**

Item Properties & Terminology

pre-familiarization items

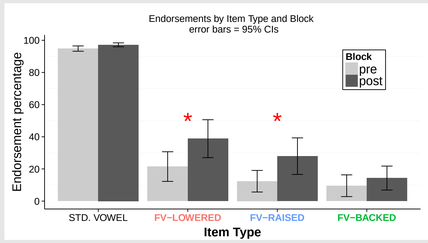
- 0.5 **high frequency**
  - 0.25 in passage
  - 0.25 not in passage
- 0.5 **low frequency**
  - 0.25 in passage
  - 0.25 not in passage

For ***in passage*** items, English frequency was confounded with occurrence frequency during familiarization (R^2=0.32): 8 occurrences on average for *high freq in-passage* items vs. 2 occurrences for *low freq in-passage* items.

Experiment 1

Analysis of endorsement patterns

- mixed logit regression on lexical decisions by item type and block (maximal slopes)
- exposure to the *front vowel lowered* accent increased "word" responses for items with both **accent-consistent** and certain **accent-inconsistent** vowel shifts.
- two sub-analyses (w. Bonferroni corrected alpha) to test for generalization



Sub-analysis 1: Generalizing learning vs. a post-familiarization response bias

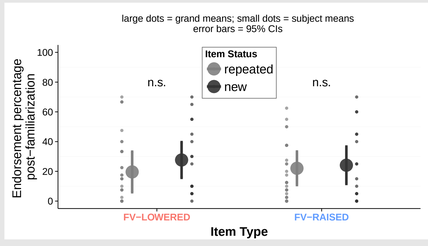
Table 1: Mean change in endorsement rates across blocks for repeated lexical decision items (standard error in parentheses).

		FV-LOWERED	FV-RAISED
Exposure status	Freq	% change	% change
In passage	High	**30.0 (5.7)**	14.7 (4.2)
	Low	17.1 (3.7)	18.2 (5.0)
Not in passage	High	25.3 (5.6)	14.7 (3.9)
	Low	19.4 (6.6)	22.4 (5.6)

- The largest endorsement increase occurred for the **accent-consistent** forms that were presented most frequently during familiarization, consistent with a learning account, rather than a simple response bias.

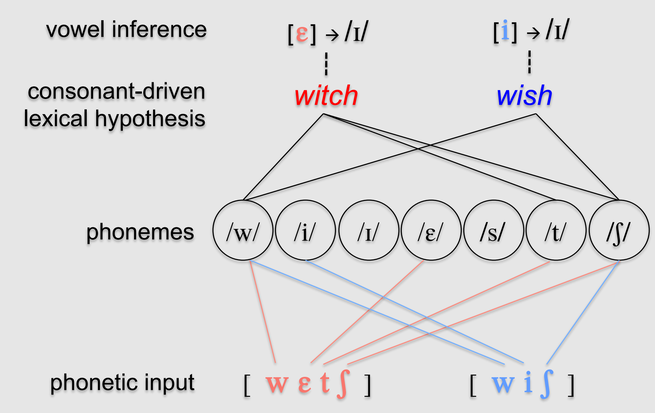
Sub-analysis 2: Generalization to new words

- mixed logit model on post-familiarization judgments for *repeated* and *new* items
- no difference in endorsement rates for *repeated* and *new* items
- thus, learning generalized to new items



Note: *repeated* denotes the subset of items that occurred in both lexical decision blocks but that were initially rejected (i.e., vowel-shifted items that were unrecognizable prior to accent learning.

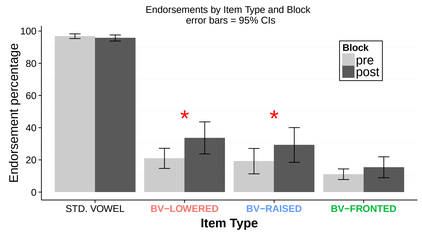
A Phonological Inference Account



Experiment 2

Analysis of endorsement patterns

- Replication of results from Expeimennt 1: exposure to the *back vowel lowered* accent increased "word" responses for items with both **accent-consistent** and certain **accent-inconsistent** vowel shifts.



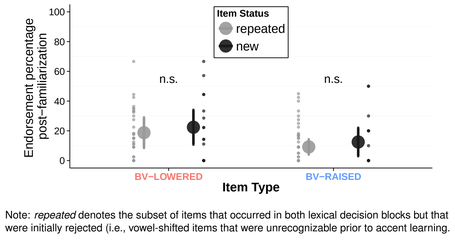
Sub-analysis 1: Generalizing learning vs. a post-familiarization response bias

Table 2: Mean change in endorsement rates across blocks for repeated lexical decision items (standard error in parentheses).

		BV-LOWERED	BV-RAISED
Exposure status	Frequency	% increase	% increase
In passage	High	**25.0 (5.2)**	16.3 (7.7)
	Low	13.8 (4.5)	6.3 (6.6)
Not in passage	High	13.8 (6.2)	14.4 (6.7)
	Low	8.5 (4.9)	9.8 (3.9)

Sub-analysis 2: Generalization to new words

- Paralleling Exp 1, no difference in endorsement rates for *repeated* and *new* items from either the **BV-LOWERED** or **BV-RAISED** sets



Note: *repeated* denotes the subset of items that occurred in both lexical decision blocks but that were initially rejected (i.e., vowel-shifted items that were unrecognizable prior to accent learning.

Conclusions

- Listeners learned the novel system of vowel shifts in the speaker's accent, which improved recognition of accent-consistent pronunciations.
- Familiarization improved recognition of *new* words, indicating that learning generalized across the lexicon
- Familiarization to a system of vowel lowering improved recognition of raised vowel forms, indicating that learning generalized to certain *structurally similar* though accent-inconsistent vowel shifts.

References

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[6] Maye, J., Aslin, R., & Tanenhaus, M. (2008). The Weckud Wetch of the Wast: Lexical adaptation to a novel accent. *Cognitive Science*, 32:543-562.
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