Perceptual Adjustments: All Pronunciations are not Created Equal

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Introduction

People pronounce sounds differently for different reasons. Two ubiquitous reasons are:

1. The Context (e.g., Liberman et al., 1954) Contextually-driven changes are pervasive in dialects.

Examples of (contextually-driven) dialectal variations

R-dropping (Where did you pahk the car?): Boston speakers drop /r/'s after vowels, but never when /r/ is the first sound in a word, or when it occurs after a consonant

T-flapping (latter [ladr] = ladder [ladr]): American English speakers 'flap' /t/'s when they occur intervocalically, but never when they start a stressed syllable

Place assimilation (/s/ = ?s∫ before a [tr] cluster, as in 'street' or 'construction'): In many Northeastern US dialects, /s/ becomes like /∫/ (sh), but only before a [tr] cluster

2. The Speaker (e.g., Peterson & Barney, 1952) – A speaker's age, gender, and linguistic experience will determine the acoustic realization of any particular sound.

Examples of (speaker-driven) idiolectal variations

Lisps, *foreign accents*, *temporary physical states* (food in one's mouth, being drunk)

The Question: How do listeners handle variation in pronunciation?

Previous Research: Psycholinguistics

1. Listeners get rid of variability: Evidence based on contextually-driven variation

How might this work? One option: feature parsing (Gow et al.):
Listener hears a sound that's assimilated: [?s∫] in *[street]*

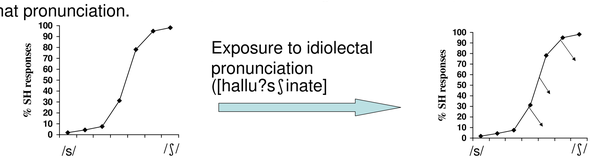
They decode the features present in that sound: Some features are consistent with /s/, other (weaker) features are consistent with /∫/

So they 'assign' the weaker features to the subsequent sound:

[?s∫] → (weaker features) → [tr] = /s/ + [tr]

2. Listeners represent variability: Evidence based on speaker-driven variation

How might this work? One option: perceptual learning:
'odd' pronunciations result in phonemic categories that are expanded to accommodate that pronunciation.



Previous Research: Sociolinguistics

The different psycholinguistic accounts are based on different types of variation, but speech recognition models do not consider the source of a variation. Perhaps these models should? After all, listeners appear to:

3. Listeners use variability to form attributions about speakers: Speech perception, in turn, may be mediated by listeners' beliefs about the speaker

- Listeners' perceptual boundaries for a fricative contrast (/s/-/∫/) or a vowel contrast (/U/-/ʌ/) shifted depending on whether they saw a male or a female face 'producing' syllables which contained those sounds (Strand and colleagues)
- Listeners perceived vowels differently depending on what they believed to be the dialect of the speaker they were listening to (Niedzielski, 1999)

Our Research

Question

Does the source of a particular variation determine how the perceptual system adjusts to it?

Specifically: Is perceptual learning the same after exposure to **Dialectal** variation as after exposure to **Idiolectal** variation?

?s∫ as an Idiolect vs. as a Dialect – Background

Idiolectal variation (not contextually-constrained) → perceptual learning:

- /s/ in words like *hallucinate*, *obscene*, *parasite*
- /s/ replaced with a sound midway between /s/ and /∫/ (?s∫)
- Listeners expand their category for /s/ to accommodate this idiolectal pronunciation (Kraljic & Samuel, 2005)

Dialectal variation (contextually-constrained) → ?? → perceptual learning?

- NY/LI dialect: /s/ becomes ?s∫ when it immediately precedes [tr] (*street*)
- Acoustically: Idiolect ?s∫ and Dialect ?s∫ are identical
- Perceptual system's task is also identical: Recognize the underlying /s/
- ONLY the source of the variation differs (*Idiolectal vs. Dialectal*)

Experiment Method

Experimental Groups

Phase 1: Exposure (Lexical Decision) – Two groups

Purpose: To expose listeners to a speaker whose pronunciation of /s/ is ambiguous (?s∫)

Manipulation: Ambiguity was attributable either to an Idiolect or to a Dialect

1. *Idiolectal pronunciation*: [?s∫] replaced /s/ in a variety of lexical contexts (e.g., *hallucinate, obscene*)
2. *Dialectal pronunciation*: [?s∫] replaced /s/ only in when it immediately preceded [tr] (e.g., *construction, abstract*)

Phase 2: Category Identification Test

Purpose: to assess whether perceptual learning occurred for each exposure group

Task: All participants categorized items on a VCV continuum; C ranged /s/-like to /∫/-like

All participants: [asi] – [a∫i] continuum

Control Group

Phase 1: None

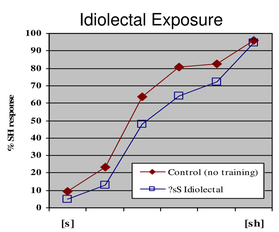
Phase 2: Same as experimental groups

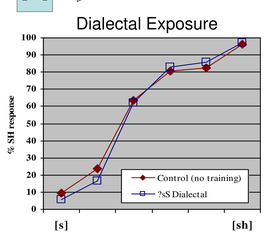
Purpose: To provide a baseline to which experimental groups' responses were compared. If exposure resulted in perceptual learning, participants in the experimental group(s) should have significantly more /s/ responses than those in the control group.

Experiment Results

Listeners exposed to (?s∫) as an Idiolectal variation → perceptual learning

Listeners exposed to (?s∫) in Dialectal contexts → X → no perceptual learning





Why does dialectal exposure not lead to perceptual learning?

We think: Dialectal and Idiolectal variation are processed differently.

But one could argue that the lack of an effect might simply reflect:

- Many of our participants speak this dialect so…no need to adjust [str]?
- Perceptual learning is context-specific and so…the [asi]-{ashi} categorization task may have failed to measure adaptation to dialectal variation?

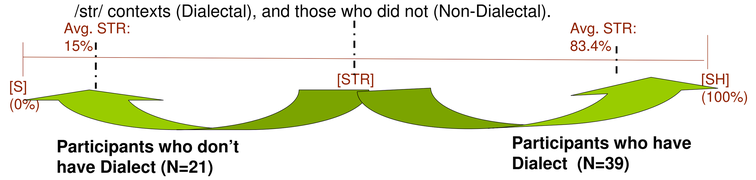
Lack of perceptual learning: Because participants have this dialect? NO

To investigate, we had participants from the experiment read aloud 10 sentences that contained words with /s/, /∫/ and /str/.

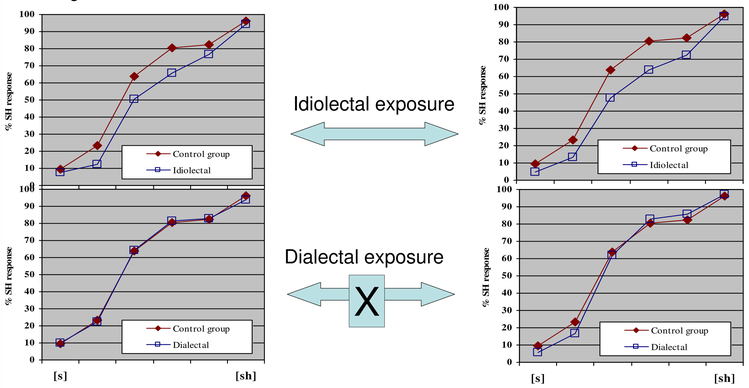
We obtained the mean frequency for each participant's /s/ (S), /∫/ (SH), and the /s/ in /str/ (STR). Within a speaker, /∫/ is always lower frequency than /s/.

We calculated the difference between each participant's S and their STR as a percentage of the difference between their S and SH. A person's STR production could then be assigned a value of 0% (perfectly equal to their S pronunciation), a value of 100% (equal to their SH pronunciation), or any number in between.

On the basis of these frequencies, we split participants into two groups: Those who exhibited ?s∫ in /str/ contexts (Dialectal), and those who did not (Non-Dialectal).



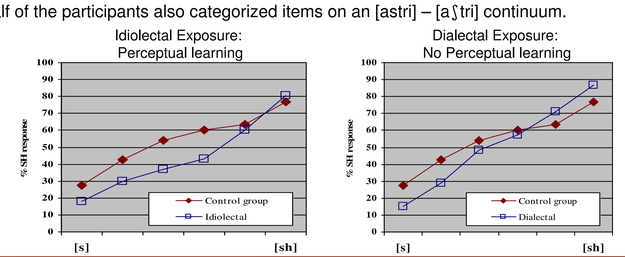
Both groups showed identical patterns of results: Perceptual learning of idiolectal variation, no learning for Dialectal variation:



Participants' own dialect doesn't account for the difference in perceptual learning

Lack of perceptual learning: Dialectal learning not captured by [asi]-[a∫i]?

Half of the participants also categorized items on an [astri] – [a∫tri] continuum. NO



Conclusions

All acoustic-phonetic variations are not treated identically by the perceptual system.

- Exposure to idiolectal pronunciation → general retuning of phonemic categories, even for phonetic contexts that were not in the exposure set.
- Exposure to the same pronunciation in the context of a dialect → X → no perceptual learning.