Listeners compensate for asymmetric sound change distribution of /s/-retraction in American English

Jacob B. Phillips *Phonology Laboratory, University of Chicago*

Introduction

Compensation for coarticulation

➢ Listeners compensate for coarticulation, filtering out context-induced variation to recover the intended message

E.g.: Mann & Repp (1980)

- /s/ has a lower center of gravity preceding /u/ due to coarticulatory lip rounding
- When listeners are presented with an ambiguous stimuli between [s] and [ʃ], they are more likely to give [s] responses preceding rounded vowels

Compensation & sound change

➢ Sound change is thought to begin when listeners do not compensate for extreme coarticulatory information (Ohala 1993)

➢ Instead, listeners encode a new speech target, which may influence later productions, even in environments without coarticulatory triggers

➢ Yet, little experimental work has examined the role of compensation a sound change in progress

E.g.: Harrington et al. (2008)

- In British English: /u/ fronts...
  - preceding coronals for older speakers
  - across the board for younger speakers
- Younger speakers compensate for coarticulation less than older speakers
- Younger speakers' boundaries were shifted toward /i/ in response to the sound change

Focus: /s/-retraction

➢ An ongoing sound change where /s/ approaches [ʃ] due to anticipatory coarticulatory to /ɹ/ (Shapiro 1995, Baker 2015)

➢ Robustly reported in /stɹ/ clusters:

✓ 'string' /stɹɪŋ/ ⟶ [ʃtɹɪŋ]

➢ Rarely reported for other clusters:

✗ 'script' /skɹɪpt/ ⟶ [ʃkɹɪpt]

✗ 'spritz' /spɹɪts/ ⟶ [ʃpɹɪts]

➢ However, while /t/ slightly lowers /s/ in /st/ clusters (Baker 2011), there is no clear coarticulatory explanation for the asymmetric distribution of the phenomenon

➢ English phonotactics do not permit /ʃ/ preceding stops, potentially encouraging more extreme coarticulation without the need to maintain a phonological contrast between /s/ and /ʃ/

Research question

Unlike /u/-fronting, /s/-retraction is is still limited to one coarticulatory environment, so: **do listeners compensate for retraction in /stɹ/ clusters but not /spɹ/ or /skɹ/ clusters?**

Data visualization

Figure 1: Percentage of /ʃ/ responses (y-axis) as a function of increased /ʃ/ mixing ratio (x-axis) by target cluster (COLOR: red = /stɹ/, green = /skɹ/, blue = /spɹ/).

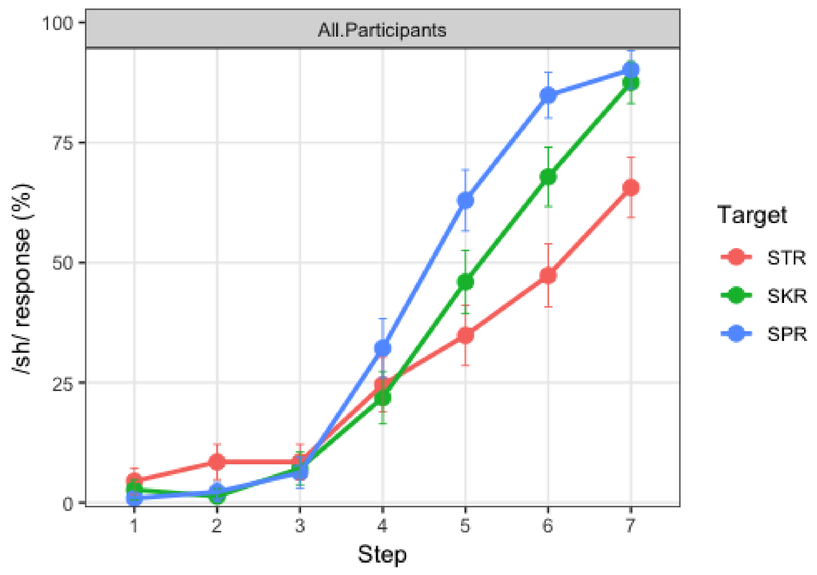


Figure 2: Individual variation (panels) in percentage of /ʃ/ responses (y-axis) as a function of increased /ʃ/ mixing ratio (x-axis) by target cluster (COLOR: red = /stɹ/, green = /skɹ/, blue = /spɹ/).

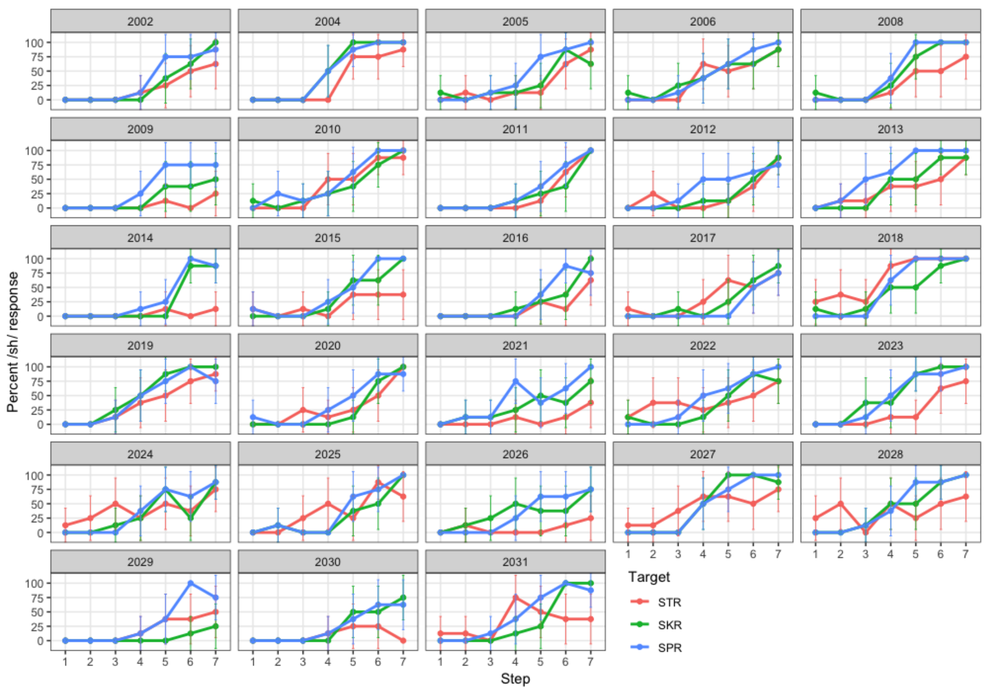
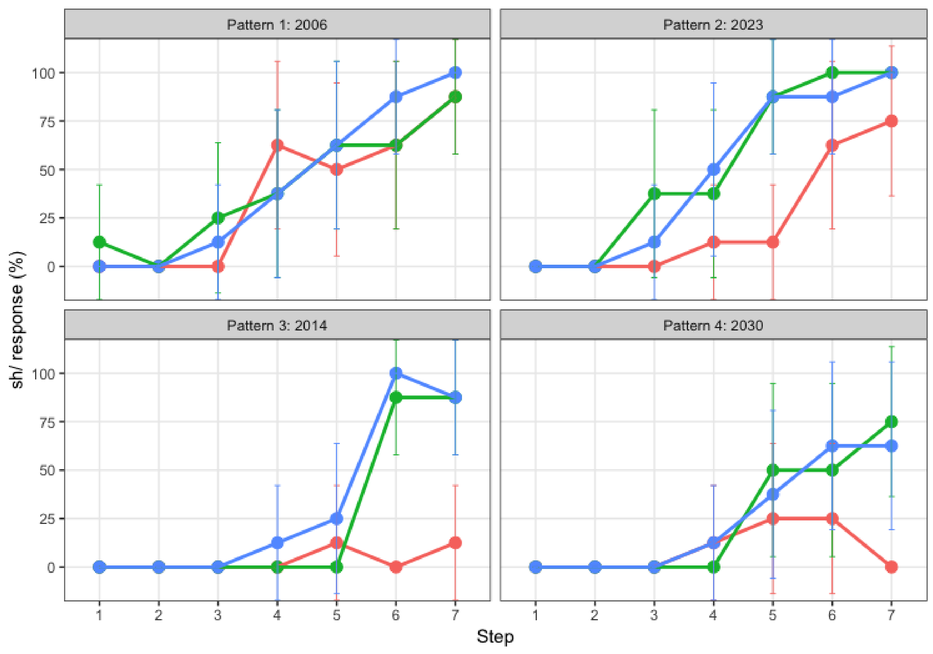


Figure 3: Four individuals typifying the four observed perceptual patterns.



Methods

➢ **Task**: A nonce word forced-choice 'lexical' decision task

➢ **Stimuli**: Nonce words containing /SCr/ onsets

- Necessitated by the lack of phonological contrast between /s/ and /ʃ/ preconsonantally
- Citation nonce words recorded by two model talkers (males, ages 19 and 21)

simble	shimble
sprimble	shprimble
strimble	shtrimble
scrimble	shcrimble

- Onsets from 'simble' & 'shimble' were extracted and digitally mixed to create a 7-step continuum from /s/ to /ʃ/
- Each step was cross-spliced onto the preconsonantal targets, creating a continuum from [s{p,t,k}ɹɪmbəl] to [ʃ{p,t,k}ɹɪmbəl]

➢ **Participants**: 31 UChicago students were recruited for course credit

➢ **Procedure**: Participants responded with a key selection corresponding with nonce word choices presented orthographically

➢ **Analysis**: Responses (/s/ vs. /ʃ/) modeled using logistic mixed models with speaker, step and target

Discussion

➢ Listeners are more likely to hear /s/ at higher steps in /Stɹ/ than in /Spɹ/ or /Skɹ/

- Cannot be only a phonotactic bias, since /ʃ/ is illicit preceding /k/ and /p/ too

➢ Compensation is not just a shift in the response curve, but a dampening in /ʃ/ responses

- Possible due to phonotactics, as listeners can perceive unambiguous /ʃ/ in isolation as /s/ preceding /tɹ/

➢ Robust degree of individual variation observed.

Individual response patterns

1. No compensation, i.e. no effect of cluster
2. Compensation for retraction, i.e. increased /s/ response in /stɹ/ clusters
3. Total compensation for retraction, i.e. no /ʃ/ responses at all in /stɹ/ clusters
4. Compensation in all clusters

➢ Individual perception strategies for /s/-retraction perception may be indicative of their experience and phonologies

- Individuals exhibiting no compensation (Pattern 1) may come from communities where /s/-retraction is not yet common
- Individuals exhibit total compensation (Pattern 3) may come from communities that have phonologized retraction

Selected references: **Baker**, A., D. Archangeli & J. Mielke. 2011. Variability in American English s-retraction suggests a solution to the actuation problem. LVC 23. 347–374. • **Harrington**, J., F. Kleber & U. Reubold. 2008. Compensation for coarticulation, /u/-fronting, and sound change in standard southern British: an acoustic and perceptual study. JASA 123(5). 2825–2835. • **Mann**, V. A., & Repp, B. H. 1980. Influence of vocalic context on perception of the [sh]-[s] distinction. Percept Psychophys, 28, 213–228. • **Ohala**, J. 1993. The phonetics of sound change. In C. Jones (ed.), Historical linguistics: Problems and perspectives, 237–278. London: Longman. • **Shapiro**, M. 1995. A case of distant assimilation: /str/ ⟶ /ʃtr/. Am Speech 70(1). 101–107.