

Novelty and frequency: An experimental investigation of perceptual linguistic saliency in unfamiliar speech

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Outline

- 1 Saliency
 - Saliency in SLA
 - Definition
 - Sources of Saliency
- 2 Experiment
 - Participants
 - Design
 - Materials
- 3 Results
 - Dorsal Fricatives
 - Alveolar Fricatives
 - Post-alveolar Fricatives
- 4 Conclusions

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Acquisition of Novel L2 Sound Inventory

what does a learner notice

- One of the major challenges for second language (L2) learners is acquiring a novel L2 sound inventory that differs from their native language (L1).
- Perception of novel L2 sounds is filtered through their L1 [Dupoux et al, 1999].
 - Can **facilitate** L2 acquisition and production
 - Can **hinder** L2 acquisition and production
- Unclear which sounds an L2 learner notices or is aware of

Acquisition of Novel L2 Sound Inventory

what does a learner notice

- Intuitive notion that some L2 sounds seem to be more “noticeable” than others
 - “obvious”
 - “prominent”
- Not clear what actually determines a sound’s “noticeability” or “saliency”
- This characteristic has been termed “saliency.”

Saliency

Previous Literature

A clear (and useful) definition lacking

- elusive
- largely intuitive

Previous attempts at defining it rely further on vague concepts

- “some way perceptually and cognitively prominent”
[Kerswill & Williams, 2002, p. 81]
- “easily noticeable, prominent or conspicuous” [Siegel, 2010,
p. 129]

Saliency

Current Deficit

Saliency remains unquantified

- Lacks an empirically objective definition
- Similar to other “intuitive” terms
 - Ease of articulation
 - Difficulty
 - Similarity
 - Markedness

Possible Sources of Saliency

- The factors that underlie a segment's saliency to listeners unfamiliar with a given language are unclear
- Intuitively many different potential sources of saliency
 - Frequency of a sound
 - Similarity
 - Rarity
 - Acoustics
 - Social-Psychology
 - etc

Each source predicts specific segments as salient

Models of Saliency

- Make model with different testable predictions
- Each model predicts specific segments as salient
- Can check against what is identified/noticed by listeners

Models of Saliency

- Acoustics
- Psychoacoustics
- Social-Psychology
- Typological Frequency
- Similarity
- Novelty
- Frequency
 - Absolute token frequency
 - Token frequency to L1 type frequency
 - Rarity

Subset of Models

Frequency

Salient=Sounds that are the most frequent in the stimuli

A pattern we might expect is that token frequency of occurrence within a sample is a factor in a sound being identified as salient

Subset of Models

RelativeFrequency

Salient=Sounds that are more frequent than sounds in your L1

A pattern we might expect is that the token frequency of occurrence compared to the type frequency of that segment in your lexicon is a factor in a sound being identified as salient.

Novelty

Salient=Sounds that aren't in your L1

A pattern we might expect is that sounds that aren't in your L1 are identified as salient

- [t d c ʃ q ɟ]
- [ɸ β ɣ ʒ ʒ̥ ʒ̥ x ɣ χ ʋ ʰ ʁ]
- [β r ɹ]
- [ŋ ɲ ɲ ɳ]
- [ɸ ʒ ʒ ʌ ɹ]

Three Possible Sources

- **Novelty**
 - Salient=Sounds that aren't in your L1
- **Frequency**
 - Salient=Differences in frequency for a given sound between L1 and audio sample
 - Salient=Token frequency of a given sound
- Compare models to results of a perception experiment
- Restrict this investigation to fricatives

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Participants

- American English L1 speakers
- Unfamiliar with any variety of Hebrew or Arabic
- Recruited from CUNY Graduate Center (N=26)
- This talk only looks at a sub-set of participants (the first 18).

Participants

- Non-linguists (N=7)
- Linguists (N=12)
 - Phoneticians, Phonologists, and Language Documenters were excluded
 - One Linguist excluded due to misunderstanding the task



Design

- Language samples presented using E-Prime 2.0 [Psychology Software Tools, Pittsburgh, PA]
- Quiet room with a headphones and a headphone mounted microphone.
- Responses recorded using Audacity and transcribed in Praat [Boersma & Weenink, 2013]
- Paper language background questionnaire



Instructions

- 1 Listen for any sound(s) (e.g. consonants, vowels, syllables) that jump out at you
- 2 REPEAT any sound(s) (e.g. consonants, vowels, syllables) that you noticed in the previous passage to the best of your ability

Stimuli

- Language Samples of translations of Aesop's fable "The North Wind and the Sun" (except Defaka).
 - Male and Female speakers
 - Mean length=46.24 seconds (range=24 sec – 73 sec)
- Stimuli downloaded from:
 - IPA Handbook
 - Edinburgh IPA
 - UCLA Phonetics Archive

Play Sound

Stimuli Types

Varied by

- non-English fricative (Novelty)
 - Pharyngeal fricatives: [ħ ʕ]
 - Dorsal fricatives: [x ɣ χ ʁ]
- Relative Frequency of English fricative
 - High frequency [ʃ]: probability > .0140
 - Low frequency [ʒ]: probability < .0140

Table : Stimuli Type

| Type | Phoneme in Stimuli | | | [ʃ] Frequency |
|--------|--------------------|-----------|-----|------------------|
| | [ħ ʕ] | [x ɣ χ ʁ] | [ʃ] | |
| I | ✓ | ✓ | ✓ | high low |
| II | | ✓ | ✓ | |
| III | | | ✓ | |
| IV | | | ✓ | |
| Filler | | | | |

Five types of stimuli

Stimuli Languages

Table : Stimuli Languages

| Type | Language | |
|--------|---|-------------------------|
| I | Arabic, Egyptian Arabic, Modern Standard | Modern Sephardi Hebrew |
| II | Bulgarian Dutch | Modern Ashkenazi Hebrew |
| III | Galician Hungarian | Portuguese, European |
| IV | Amharic Norwegian, Bokmål | Swahili |
| Filler | Defaka | Icelandic |
| | Efik | Norwegian, Bjørnvatn |
| | Estonian | Sindhi |
| | Finnish | Swedish |
| | Hindi | |

Stimuli Presentation

- Each stimulus presented twice
- Two Blocks
 - Pseudorandomized
 - approx. 20 minutes

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Responses

Range of responses (participant idiosyncrasies):

- Longer non-words
 - [ʃah χots χav]
- A syllable
 - [ʃa] [χa]
- One sound
 - [ʃ:]
- “Don’t remember”
- “Nothing”

Responses

Ways of talking about “dorsal fricatives”

- [taxtax taxtax] it’s a very phlegmy sound there in the middle [taxaxax]
- strong “h” sound [xax̥ hax̥ hax̥]. . .
- . . . sometimes with a hard “h” [xax̥ xɛx̥] sound, uh, within the, within the sentences
- all those back fricatives dude, they’re super noticeable, um, different positions, but um, they’re the most obvious, um, sound features
- uh, it was fricatives dude I can’t get over those like the velars and the glottals and the whatever fricatives. . .
- . . . lots of like, kind of velar back of the throat sounds

Responses

- Responses transcribed in Praat
- Coded for fricatives, affricatives, and rhotics
 - Place of articulation
 - Irrespective of voicing
 - Present=1 or more occurrences
 - Each fricative was coded separately even if a number of different fricatives in a single response
- Participants gave other responses (e.g. stops, vowels) but these were not coded.

Dorsal Fricatives

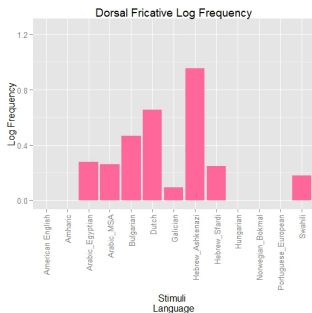


Figure : Dorsal Fricative Log Frequency

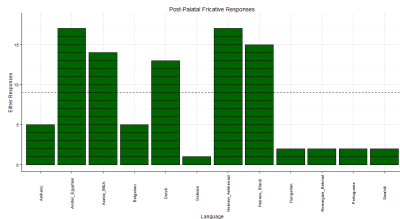


Figure : Post-Palatal Fricative Responses

Dorsal Fricatives

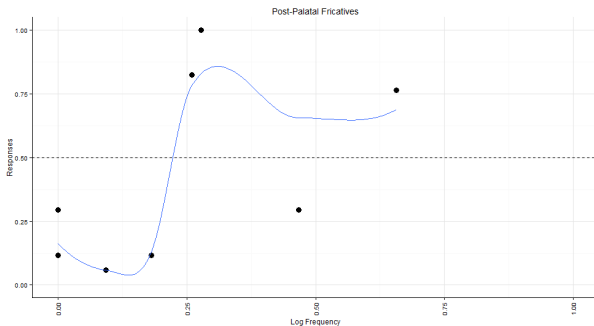


Figure : Fricative Responses and Log Frequency

Alveolar Fricatives

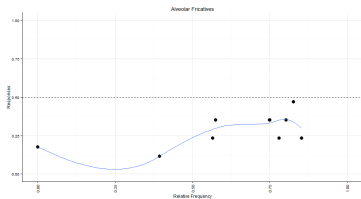


Figure : Alveolar Fricative Relative Frequency

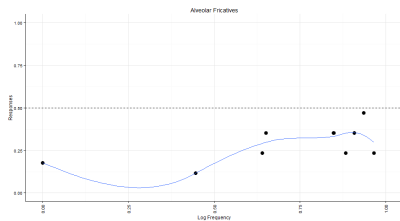


Figure : Alveolar Fricative Log Frequency Responses



Non-[s] Sibilant Fricatives

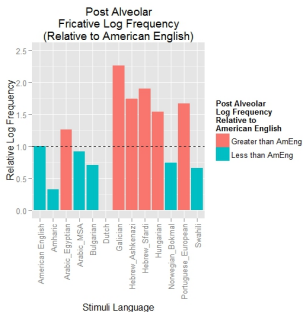


Figure : non-[s] Sibilant Relative Frequency

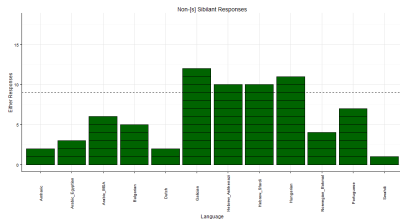


Figure : non-[s] Sibilant Responses

Non-[s] Sibilant Fricatives

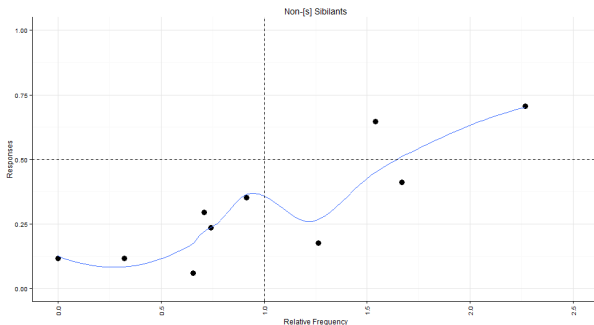


Figure : non-[s] Sibilant Responses and Relative Frequency

Non-[s] Sibilant Fricatives

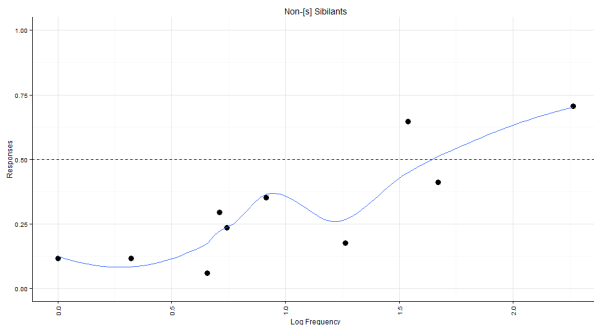


Figure : non-[s] Sibilant Responses and Log Frequency

Trends

Preliminary results show a couple of trends

- Post-palatal responses being unrelated to fricative frequency – a possible effect of novelty
- Alveolar fricative and Non-[s] sibilant responses being related to either log frequency or relative frequency

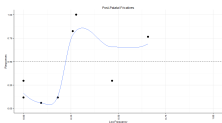


Figure : Fricative Responses and Relative Frequency

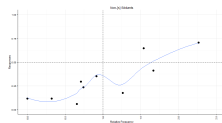


Figure : non-[s] Sibilant Responses and Relative Frequency

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Frequency

- The preliminary results suggest that frequency is a source of perceptual linguistic saliency only for segments which are in the language of the listener.

Novelty

- Mere presence of a novel segment seems to be an important factor: **Novelty Bias**
- Similar to the “novel popout” effect in visual processing [Strayer & Johnson, 2000]
- Consistent finding that L1 phonetic drift was stronger when the L2 was novel [Chang, 2013]

Future Work

- Transcribe remain participants
- Analytic statistics
- Compare results to other models of saliency

Ultimately we hope to identify major factors underlying saliency.

An empirically motivated conception of saliency ultimately helps us better understand multilingual acquisition of novel contrasts.

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Works Cited I



Audacity 2.0.3 [Computer software audio editor] (2013)

freely available for all computer platforms from:

<http://audacity.sourceforge.net/>



Boersma, P. & Weenink, D. (2013).

Praat: doing phonetics by computer [Computer program].

Version 5.3.51, retrieved 2 June 2013 from

<http://www.praat.org>



Chang, C.B. (2013).

A novelty effect in phonetic drift of the native language.

Journal of Phonetics 41: 520–533.

Works Cited II



Dupoux, E., K. Kakehi, Y. Hirose, C. Pallier, & J. Mehler (1999).

Epenthetic vowels in Japanese: A perceptual illusion?

Journal of Experimental Psychology: Human Perception and Performance, 26(6): 1568–578.



Hayes-Harb, R., & K. Masuda (2008).

Development of the ability to lexically encode novel second language phonemic contrasts.

Second Language Research, 24(1): 5–33.

Works Cited III



Kerswill, P. & A. Williams (2002).

Saliency as an explanatory factor in language change:
Evidence from dialect levelling in urban English.

In M.C. Jones, & E. Esch (Eds.). *Language Change: The Interplay of Internal, External and Extra-linguistic Factors*. Berlin: Mouton de Gruyter. 81–110.



Siegel, J. (2010).

Second Dialect Acquisition

New York: Cambridge University Press.

Works Cited IV



Strayer, D.L. & Johnson, W.A. (2000).

Novel popout is an attention-based phenomenon: An ERP analysis.

Perception & Psychophysics, 62(3): 459–470.



Tsoi, W.C.T. (2005).

The effects of occurrence frequency of phonemes on second language acquisition: A quantitative comparison of Cantonese, Mandarin, Italian, German, and American English.

Ms. Chinese University of Hong Kong.