EPISODE III: NATURALNESS STRIKES BACK
<table>
<thead>
<tr>
<th>Training, stem Vs</th>
<th>Suffix V</th>
<th>Old stems</th>
<th>New stems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Mid</td>
</tr>
<tr>
<td>High</td>
<td>Mid</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>High</td>
<td>✓</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>High</td>
<td>✓</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Low</td>
<td>✓</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Low</td>
<td>✓</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Low</td>
<td>✓</td>
</tr>
</tbody>
</table>
INTERACTION OF PHONETIC NATURALNESS, LOCALITY, AND FREQUENCY
Participants learned one of three artificial languages, consisting of:

- CVC singular stems.
- -V plural suffix, which alternated between [-u] and [-y].
- German phonemes.

Stimuli recorded naturally.
### DESIGN

<table>
<thead>
<tr>
<th>Rule</th>
<th>Frequency:</th>
<th>Infrequent (25% of trials demonstrate alternation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Natural</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>$V \rightarrow [\alpha \text{ back}] / V_{[\alpha \text{ back}]}C___ \quad ([y] \text{ after } [i, e, œ]; [u] \text{ after } [o, ҫ, ʊ])$</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Unnatural</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>$V \rightarrow [\alpha \text{ back}] / V_{[\alpha \text{ tense}]}C___ \quad ([y] \text{ after } [œ, ɪ, ʊ]; [u] \text{ after } [a, e, o])$</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Non-local</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>Unnatural</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>$V \rightarrow [\alpha \text{ back}] / C_{[\alpha \text{ son}]}VC___ \quad ([y] \text{ if } C_1 \text{ is } [m, n, l, j]; [u] \text{ if } C_1 \text{ is } [f, d, k, z])$</td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

Frequent (50% of trials demonstrate alternation)

- Frequency: 20
- Frequency: 20

- Frequency: 20
- Frequency: 20

- Frequency: 20
- Frequency: 20

- Frequency: 20
- Frequency: 20

(120 total participants)

---

Baer-Henney & van de Vijver 2012, *LabPhon*
Exposure phase

- Instructions: Pay attention to the words in this new language.
- Each trial:
  - Auditory singular or plural word played (with singular/plural pictures).
  - Only plural forms demonstrated the alternation.
  - Proportion of singular and plural words according to frequency condition.
PROCEDURE

Test phase (96 trials; novel items)

- Presented with singular word and picture, followed by plural picture.
- **Task**: Produce the correct plural form (out loud, to be recorded and later coded).

Baer-Henney & van de Vijver 2012, *LabPhon*
RESULTS

Baer-Henney & van de Vijver 2012, LabPhon
NATURAL AND UNNATURAL STRESS PATTERNS
Participants learned one of two languages:

- **Natural**: Stress leftmost low vowel, else stress leftmost vowel.
  - [\'patikæ]
  - [pu'takæ]
  - [pitu'pa]
  - [\'pitupi]

- **Unnatural**: Stress leftmost high vowel, else stress leftmost vowel.
  - [\'putæki]
  - [pa\'tuki]
  - [pæta'pu]
  - [\'pætapæ]

All items: 3- or 4-syllable nonce words.

Carpenter 2010, *Phonology*
STIMULI

Isolated syllables recorded in a carrier sentence.

• Natural duration and intensity differences between high and low vowels wiped out.
• Stress percept enhanced (pitch and intensity differences between stressed/unstressed vowels enhanced).
• Syllables then concatenated together to make the nonce words.

Near-identical items used in the two languages.

• C inventory: [p, t, k, b, d, g, s, z]
  • Same C sequences used in both languages.
• V inventory: [i, u, æ, ɑ]
  • [i, u] substituted for [æ, ɑ], and vice versa, to maintain the stress pattern.

Carpenter 2010, Phonology
PROCEDURE

Familiarization (27 items total)
• Conforming training item played, with a picture shown.

Familiar word testing
• Presented with two options (e.g. [ʼpitupi]…[pitu'pi]), with accompanying picture provided.
• Task: Does the 1st or 2nd option sound correct? (button press)
• Feedback provided (correct/incorrect).

Novel word testing (66 items total)
• Tested on novel items (same task).
• No pictures provided.
• No feedback in final test phase.

Carpenter 2010, *Phonology*
3.3 English results

One-sample t-tests on the arcsine transformed means were conducted to determine whether each mean was significantly different from expected chance level, 50%. Both the natural and unnatural groups showed that there was no significant difference between the natural and unnatural groups.

3.3.1 Pre-training

Subjects complete AXB test: 26 triplet groups.

3.3.2 Training block 1

Subjects hear 4 three-syllable training words, randomly repeated 4 times, each word represented by a unique photographic image.

Testing block 1

Subjects tested (2AFC) on the 4 three-syllable words just heard. They get feedback with the correct answer after responding to each pair presented.

Training block 2

Subjects hear 5 four-syllable training words, randomly repeated 4 times, each word represented by a unique photographic image.

Testing block 2

Subjects tested on the 5 four-syllable training words just heard, with feedback.

Review

Subjects hear the first 9 training words, presented randomly and repeated once, i.e. each word heard twice.

Testing block 3

Subjects tested on the first 9 training words, with feedback.

Training/testing blocks 4 and 5

Each training block presents new words and subjects are tested on just the words presented in that training block. Same procedure as blocks 1 and 2 above.

Review

Subjects hear the second 9 training words, presented randomly and repeated once, i.e. each word heard twice.

Testing block 6

Subjects tested on the second 9 training words, with feedback.

Review

Subjects hear the first 18 training words, presented randomly and repeated once.

Testing block 7

Subjects tested on the first 18 training words, with feedback.

First novel words test

Subjects presented with 18 novel three- and four-syllable test words. They get feedback as to the correct answers.

Training/testing blocks 8 and 9

Same procedure as training/testing blocks 1, 2, 4 and 5 above. Training and testing block 8 presents and tests a new set of three-syllable words and block 9 trains and tests a new set of four-syllable words.

Review

Subjects hear the third set of 9 training words, presented randomly and repeated once.

Testing block 10

Subjects tested on the third set of 9 training words, with feedback.

Review

Subjects hear all 27 training words, presented randomly and repeated once.

Testing block 11

Subjects tested on the 27 training words they have learned, with feedback. This test measures how well they have learned the training words.

Final novel words test

Subjects presented with 48 novel test words, with no feedback.


## RESULTS

### English speakers (n = 40)

<table>
<thead>
<tr>
<th></th>
<th>Raw score (%)</th>
<th>SD</th>
<th>Arcsine transformed score (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>English speakers (novel words)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>natural group</td>
<td>70.40</td>
<td>12.11</td>
<td>80.30</td>
<td>20.49</td>
</tr>
<tr>
<td>unnatural group</td>
<td>61.97</td>
<td>12.90</td>
<td>68.33</td>
<td>18.89</td>
</tr>
</tbody>
</table>

### Stress position

<table>
<thead>
<tr>
<th>Stress position</th>
<th>Initial (%)</th>
<th>SD</th>
<th>Medial (%)</th>
<th>SD</th>
<th>Final (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>natural group</td>
<td>69.65</td>
<td>11.93</td>
<td>72.86</td>
<td>11.57</td>
<td>68.66</td>
<td>9.74</td>
</tr>
<tr>
<td>unnatural group</td>
<td>68.42</td>
<td>8.77</td>
<td>56.84</td>
<td>11.01</td>
<td>55.64</td>
<td>11.81</td>
</tr>
</tbody>
</table>

N.B.: Equally good on trained items (90% vs. 89%)

Carpenter 2010, *Phonology*
RESULTS

Quebec French speakers (n = 40)

N.B.: They were first trained to hear stress.

<table>
<thead>
<tr>
<th>French speakers (novel words)</th>
<th>Raw score (% correct)</th>
<th>SD</th>
<th>Arcsine transformed score (% correct)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>natural group</td>
<td>59.62 $p &lt; 0.001$</td>
<td>8.92</td>
<td>64.39 $p &lt; 0.001$</td>
<td>11.70</td>
</tr>
<tr>
<td>unnatural group</td>
<td>53.71 $p &lt; 0.05$</td>
<td>6.69</td>
<td>56.88 $p &lt; 0.05$</td>
<td>7.85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stress position</th>
<th>Initial (%)</th>
<th>SD</th>
<th>Medial (%)</th>
<th>SD</th>
<th>Final (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>natural group</td>
<td>64.33</td>
<td>17.14</td>
<td>57.14</td>
<td>16.06</td>
<td>56.50</td>
<td>18.46</td>
</tr>
<tr>
<td>unnatural group</td>
<td>54.83</td>
<td>13.83</td>
<td>54.64</td>
<td>10.69</td>
<td>55.00</td>
<td>12.92</td>
</tr>
</tbody>
</table>
P-MAP BIAS
(MINIMAL MODIFICATION BIAS)
WHAT IS THE P-MAP?

Components of Steriade’s P-map proposal:

1. Speakers have a mental representation of the relative perceptual similarity of different pairs of speech sounds.
   - = the perceptibility map (P-map)
   - Context-dependent – sounds might be more or less similar in different contexts.
   - Possible fragment might look like this:

2. Speakers have a **minimal modification** bias during phonological learning.
   - They assume that phonological processes will require the smallest possible perceptual change.
MOTIVATION FOR THE P-MAP

Steriade’s main motivation for the P-map is typological, as a solution to the ‘Too-many solutions problem’.

E.g.: A restriction on final voiced obstruents could be satisfied in several ways:

• Devoicing: /tæb/ → [tæp]
• Nasalization: /tæb/ → [tæm]
• Lenition: /tæb/ → [tæw]
• Deletion: /tæb/ → [tæ]
• Insertion: /tæb/ → [tæbə]
• Reversal: /tæb/ → [bæt], and so on…

All should occur if constraints are freely ranked.

• But only devoicing is common; others are rare or unattested.

Steriade 2001/2008
Steriade's Implementation

The P-map results in a universal ranking hierarchy for faithfulness constraints:

- If $\text{Sim}(b, p) > \text{Sim}(b, m)$ after vowels, then $\text{IDENT}(\text{nasal}) >> \text{IDENT}(\text{voice})$.

<table>
<thead>
<tr>
<th>/tæb/</th>
<th>*D#</th>
<th>IDENT(nasal)</th>
<th>IDENT(voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>tæp</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>tæm</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>tæb</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This suggests a hard bias (probably too strong).

- But the same idea can be implemented as a soft bias (Wilson 2006, Zuraw 2007, White 2013).
DO LEARNERS PREFER ALTERNATIONS THAT INVOLVE PERCEPTUALLY MINIMAL CHANGES?
## DESIGN

<table>
<thead>
<tr>
<th>Condition</th>
<th>Alternations learned (sample phrases)</th>
</tr>
</thead>
</table>
| **Small phonetic distance**| (group 1) ke pamu ~ nø tamu ke zafam ~ nø zafam  
(group 2) ke jamu ~ nø samu ke dafam ~ nø bafam  
(1 feature difference: place) |
| **Medium phonetic distance**| (group 1) ke pamu ~ nø samu ke dafam ~ nø zafam  
(group 2) ke jamu ~ nø tamu ke zafam ~ nø bafam  
(2 feature difference: place & manner) |
| **Large phonetic distance**| (group 1) ke pamu ~ nø zamu ke tafam ~ nø zafam  
(group 2) ke jamu ~ nø damu ke safam ~ nø bafam  
(3 feature difference: place, manner, voicing) |

Skoruppa, Lambrechts & Peperkamp (2011), *NELS*
METHOD

Training:

Moi: (发音) [ke pamu])

Vous: (oral response)

Correct: (发音) [no tamu])

(Instructed that [ke] meant ‘small’ and [no] meant ‘big’.)

Test:

Moi: (发音) [ke pamu])

Vous: (oral response)

(No feedback)

Skoruppa, Lambrechts & Peperkamp (2011), NELS
METHOD

Participants: 36 French speakers (12 per condition)

Training phase: 36 trials (6 pairs x 6 repetitions)
  • 4 pairs of phrases with target sounds (demonstrating alternations)
  • 2 filler pairs with sonorants (no alternation).

Test phase: 36 trials (18 pairs x 2 reps)
  • 6 trained pairs
  • 12 novel pairs (8 target, 4 filler)

Stimuli recorded by French speaker; penultimate stress.

Skoruppa, Lambrechts & Peperkamp (2011), NELS
LEARNING RATE RESULTS

(a) Small Distance

(b) Medium Distance

(c) Large Distance

Skoruppa, Lambrechts & Peperkamp (2011), NELS
TEST PHASE ACCURACY

Skoruppa, Lambrechts & Peperkamp (2011), *NELS*
VELAR PALATALIZATION

Typological facts:

• Two implicational universals:
  1. Palatalization before backer vowels $\rightarrow$ palatalization before fronter vowels (recall: [i] is fronter than [e]).
  2. Palatalization of voiced velars $\rightarrow$ palatalization of voiceless velars.

• Sequence [ki] is statistically under-represented in languages.

Perceptual facts:

More similar | Less similar
---|---
[ki] / [tʃi] | [gi] / [dʒi]
[ke] / [tʃe] | [ge] / [dʒe]
[ka] / [tʃe] | [ga] / [dʒe]

DESIGN

Participants told they would be learning a novel language game.

‘Poverty of the stimulus’ paradigm (the original!)

Two languages:

• High condition:
  • Explicit palatalization of [k] and [g] before [i].
  • Explicit non-palatalization of [k] and [g] before [a].
  • No examples of [k] or [g] before [e].

• Mid condition:
  • Reverse (palatalization before [e], no input for velars before [i]).

Wilson 2006, *Cognitive Science*
STIMULI

Exposure input

<table>
<thead>
<tr>
<th>Condition</th>
<th>Trial Type (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>kiCV ... t̂ĵiCV (4) giCV ... d̂ʒiCV (4)</td>
</tr>
<tr>
<td>Mid</td>
<td>keCV ... t̂ĵeCV (4) geCV ... d̂ʒeCV (4)</td>
</tr>
<tr>
<td>Both</td>
<td>kaCV ... kaCV (3) gaCV ... gaCV (3)</td>
</tr>
<tr>
<td></td>
<td>piCV ... piCV (3) biCV ... biCV (3)</td>
</tr>
<tr>
<td></td>
<td>peCV ... peCV (3) beCV ... beCV (3)</td>
</tr>
<tr>
<td></td>
<td>pACV ... paCV (3) baCV ... baCV (3)</td>
</tr>
</tbody>
</table>

Test stimuli (same for both conditions)

<table>
<thead>
<tr>
<th>Critical trial type (number)</th>
<th>Filler trial type (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kiCV ... (8) giCV ... (8)</td>
<td>piCV ... (6) biCV ... (6)</td>
</tr>
<tr>
<td>keCV ... (8) geCV ... (8)</td>
<td>peCV ... (6) beCV ... (6)</td>
</tr>
<tr>
<td>kaCV ... (6) gaCV ... (6)</td>
<td>paCV ... (6) baCV ... (6)</td>
</tr>
</tbody>
</table>

Wilson 2006, *Cognitive Science*
PROCEDURE

Exposure phase:

I say…

... You say…

[kimə]

[tʃimə]

Test phase:

Same but participants had to produce an oral response.

Wilson 2006, Cognitive Science
PREDICTIONS?
Wilson (2006), *Cognitive Science*
SALTATORY ALTERNATION: A GROSS VIOLATION OF THE P-MAP
Example from Campidanian Sardinian (Bolognesi 1998):
- p → β/ V __ V, but /b/ remains unchanged

[pǎi] → [s:u βǎi] ‘the bread’
[bǐu] → [s:u bǐu] ‘the wine’

Hayes & White (in press), *Phonology*
Example from Campidanian Sardinian (Bolognesi 1998):
- \( p \rightarrow \beta/ V \_ V \), but /b/ remains unchanged

[p\(_{\text{ai}}\) \( \rightarrow [s:u \ \beta_{\text{ai}}] \) ‘the bread’ 2 feature changes
[b\(_{\text{iu}}\) \( \rightarrow [s:u \ b_{\text{iu}}] \) ‘the wine’

Hayes & White (in press), *Phonology*
NOT DERIVABLE IN CLASSICAL OT

For /p/ → [β]:

<table>
<thead>
<tr>
<th>/ V p V/</th>
<th>*V[-voice]V</th>
<th>*V[-cont]V</th>
<th>IDENT(cont)</th>
<th>IDENT(voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V β V</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>V p V</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>V b V</td>
<td>!</td>
<td>!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>V Ø V</td>
<td>!</td>
<td>!</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

For /b/ → [b]:

<table>
<thead>
<tr>
<th>/ V b V/</th>
<th>IDENT(cont)</th>
<th>*V[-cont]V</th>
</tr>
</thead>
<tbody>
<tr>
<td>V b V</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>V β V</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

Hayes & White (in press), *Phonology*
NOT DERIVABLE IN CLASSICAL OT

For \(/p/ \rightarrow [\beta]::

<table>
<thead>
<tr>
<th>/VpV/</th>
<th>*V[-voice]V</th>
<th>*V[-cont]V</th>
<th>IDENT(cont)</th>
<th>IDENT(voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\overset{\diamond}{V}\beta V)</td>
<td>!</td>
<td>!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(VpV)</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(VbV)</td>
<td>*!</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(V\phi V)</td>
<td>*!</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

For \(/b/ \rightarrow [b]::

<table>
<thead>
<tr>
<th>/VbV/</th>
<th>IDENT(cont)</th>
<th>*V[-cont]V</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\overset{\diamond}{V}bV)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(V\beta V)</td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>

A ranking paradox!!

Hayes & White (in press), *Phonology*
DO LEARNERS DISPREFER SALTATORY ALTERNATIONS?
EXPOSURE PHASE

[kamap]

White (2014), Cognition
EXPOSURE PHASE

[kamavi]

White (2014), Cognition
1. Exposure phase
PROCEDURE

1. Exposure phase
   [kamap]

2. Verification phase
   [kamap]
   No
   Yes ← 80% correct?

3. Generalization phase
   [lunub]

White (2014), Cognition
EXPOSURE INPUT

Potentially Saltatory condition

\[ p \rightarrow v \rightarrow \emptyset \]

Control condition

\[ b \rightarrow v \rightarrow \emptyset \]

Both conditions: non-alternating filler sounds [m, n, l, r, s, ʃ]

From now on, I will be representing only the labials for simplicity.

White (2014), Cognition
Control condition input:

\[ b \]
\[ \downarrow \]
\[ v \]

(also: \( m \rightarrow m, n \rightarrow n, l \rightarrow l \) ...)

Possible interpretations:

\[ \bigcirc_p \quad b \quad \bigcirc_f \quad v \]

Non-saltatory

No new alternations posited

\[ p \quad b \]
\[ \quad \downarrow \]
\[ f \quad v \]

Non-saltatory

New alternations posited

White (2014), *Cognition*
Potentially Saltatory condition input:

\[ p \rightarrow v \]

(also: \( m \rightarrow m, n \rightarrow n, l \rightarrow l \ldots \))

Possible interpretations:

Saltatory
No new alternations posited

Non-saltatory
New alternations posited

White (2014), *Cognition*
PREDICTIONS?
RESULTS (GENERALIZATION PHASE)

Potentially Saltatory condition

Input:
- p

Results:
- p
  - f: .45
  - b: .96
  - v: .70

Control condition

Input:
- b

Results:
- p
  - f: .45
  - b: .21
  - v: .89
To evaluate these differences, a mixed logit model was fitted, predicting log odds of having a changing response for words ending in untrained target sounds. The final model included fixed effects for Condition (Potentially Saltatory vs. Control), Sound Type (stops vs. fricatives), and a Condition \times Sound Type interaction. Random intercepts for subjects and by-subject random slopes for Sound Type were also included. By-subject random slopes were included because they significantly improved model fit according to a likelihood ratio test, \( \chi^2(3) = 75.62, p < .001 \).

Random intercepts for individual words were not included in the final model because they did not significantly improve model fit, \( \chi^2(1) = .12, p = .72 \).

The fixed effects for the final model are provided in Table 2. The significant negative intercept indicates that untrained fricatives in the Control condition (coded as the baseline in this model) were changed infrequently. The non-significant main effect of Sound Type follows from the fact that untrained stops were also changed infrequently in the Control condition. Condition was a significant predictor in the model, indicating that participants chose the changing option for words in the Potentially Saltatory condition (i.e., those with final intermediate sounds) significantly more often than for words in the Control condition. These results are consistent with the main prediction: participants changed untrained sounds more often when they were intermediate between a potentially saltatory alternation. There was also a significant interaction, indicating that untrained stops were changed more frequently than untrained fricatives, but only in the Potentially Saltatory condition.

### Table 2

Summary of the fixed effects for untrained sounds in Experiment 1.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>Wald</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.80</td>
<td>.57</td>
<td>4.87</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Condition = Potentially Saltatory</td>
<td>2.35</td>
<td>.78</td>
<td>3.02</td>
<td>.002</td>
</tr>
<tr>
<td>Sound Type = Untrained stops</td>
<td>.33</td>
<td>.72</td>
<td>.46</td>
<td>.65</td>
</tr>
<tr>
<td>Interaction = Potentially Saltatory &amp; Untrained stops</td>
<td>2.80</td>
<td>.97</td>
<td>2.89</td>
<td>.004</td>
</tr>
</tbody>
</table>

---

In principle, it was possible to have three cycles, but no participant who completed Experiment 1 within the allotted hour had more than two cycles of the exposure phase.
Explicitly Saltatory condition

Input:

\[ p \quad b \]

\[ \rightarrow \quad v \]

Results:

\[ p \quad b \]

\[ \rightarrow \quad f \\
\rightarrow \quad v \]

\[ f \rightarrow v \]

\[ f \rightarrow .53 \]

\[ .94 \]

\[ .21 \]

\[ .53 \]

\[ .22 \]

Control condition

Input:

\[ p \quad b \]

\[ \rightarrow \quad v \]

Results:

\[ p \quad b \]

\[ \rightarrow \quad f \\
\rightarrow \quad v \]

\[ f \rightarrow v \]

\[ f \rightarrow .22 \]

\[ .22 \]

\[ .94 \]

\[ .06 \]

\[ .06 \]

White (2014), Cognition
REFERENCES


