On the Disparity between Within- and Cross-Language Segmental Similarity

Charles B. Chang

University of Maryland, College Park

cbchang@umd.edu

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Outline

1. Background
   - Phonological Similarity
   - Research Questions

2. Paradigmatic Phonemics
   - Cross-Linguistic Perception
   - Cross-Linguistic Production
   - Loanword Adaptation

3. Discussion
   - Phonetics-Phonology Interface
   - Future Directions
Why care about phonological similarity?

**Phonological similarity**: similarity between two sound structures (segments, syllables, prosodic patterns, etc.).

Phonological similarity is invoked to explain:

- substitution patterns in **L1 production** [Page et al. 2007]
- substitution patterns in **L2 production** [Major 1987]
- L1-L2 correspondences in **loanword phonology** [Kang 2008]
- perceptual assimilations in **L2 perception** [Best and Tyler 2007]
- cross-language linkages in **bilingualism** [Flege 1995, Laeufner 1996]
Phonological similarity within a language

Two phones are similar if they:

1. are acoustically/auditorily close
2. do not contrast in the inventory
3. participate in a productive alternation [Johnson and Babel 2010]

E.g.: English speakers perceive [d] as similar to [r], while Spanish speakers perceive [d] as similar to [ð]. [Boomershine et al. 2008]
Encoding phonological similarity in the grammar

A language-universal “P-map”: phonological similarity effects emerge from a set of ranked constraints relating perceptually similar vs. dissimilar forms. [Steriade 2009]

- e.g.: *D–DV/_$ $\gg$ *D–T/_$

... *D$ is repaired by devoicing (not epenthesis)

Prediction of the P-map: output patterns follow perceptual similarity relations between an input and its possible outputs.
What about cross-linguistic mapping?

Unfaithful production of novel input clusters does not follow from perceptual similarity. [Shaw and Davidson 2011]

- fricative-stop clusters (e.g., [fp]): most perceptually similar to əFS, but produced as FəS

- influence of recoverability and uniformity
Cross-linguistic phonological similarity

Why does the P-map seem to be suspended in cross-linguistic circumstances?

Useful heuristic for determining similarity between L1 and L2 segments: “phonetic symbol test” (supplemented with acoustic and perceptual data). [Flege 1996]

A “phonetic symbol test” ~ cross-linguistic phonemic analysis.
Hypothesis: paradigmatic comparisons between languages at the phonemic level are predominant in bilinguals’ mapping of L2 segments to L1 segments.

- **Relative** position in acoustic space (e.g., English /u/ is located at the NE corner of $F_1 \times F_2$ space, like the /u/ of Mandarin, French, etc.)

- Distributional patterns (e.g., English /u/ has a restricted distribution with the glide /w/, like the /u/ of Mandarin, French, etc.)

Prediction: L2 users will show L1-L2 mappings that follow phonemic similarity over acoustic/auditory and phonetic similarity.
Perceptual similarity does not follow straightforwardly from acoustic similarity.

e.g.: perceptual assimilation of unfamiliar vowels to phonemically similar vowels (instead of acoustically closer vowels)

- L1 Canadian English speakers perceive German /u/ as a better exemplar of English /u/ than German /y/. [Polka and Bohn 1996]

- L1 American English speakers perceive French /y œ/ and German /y y ø œ/ as closer to English back rounded vowels than English front unrounded vowels. [Strange et al. 2004]
Americans’ production of French /u/ and /y/

French /y/:
- Produced close to French norms

French /u/:
- Influenced by English norms

[Flege 1987]

**Figure 3.** The mean F₂ frequency, in Hz, in tokens of /u/ in *tous* (■) and /y/ in *tu* (□) produced by four groups of L2 learners and a group of monolingual speakers of French. Most mean are based on 70 observations; the brackets enclose ±1 standard deviation.
Americans’ production of Mandarin /u/ and /y/

[Chang et al. 2011]

[Graph showing the production of Mandarin /y/ and English /u/ by native Mandarin, HE heritage, LE heritage, and late learners, with data points plotted on a scatter plot with Mean F1 and Mean F2 values in Bark units.]

Within- and Cross-Language Segmental Similarity
Americans’ production of Portuguese /p t k/ 

Portuguese /p t k/: influenced by English long-lag voiceless (not voiced) stops [Major 1992]
A Brazilian’s production of Portuguese /p t/:

- **Figure 1.** Mean VOTs of Portuguese [p] (English [p]) and Portuguese [t] and English [t].

  - Because we had different numbers of words and different words in the two languages, we did not use word as a factor in the foregoing analyses. In separate analyses, with the factors recent experience and word performed on each consonant in each language, we found no interaction of recent experience with word for English [t] or Portuguese [t] but significant interactions for both English [p] and Portuguese [p].

  - For English [p], three of the four words uttered during both US sessions had longer VOTs than those of these same words uttered during the Brazil session. For the fourth word, the average VOT in the second US session was shorter than that in the Brazil session.

  - For Portuguese [p], every word except one has longer VOTs in both US sessions than in the Brazil session.

**General discussion:**

With just a few months of exposure at a time in the US and Brazil, our speaker manifested gestural drift, that is, a change in VOT reflecting a change in the relative phasing of a laryngeal devoicing gesture and an oral constriction gesture. This difference in VOT was of approximately the same magnitude in the two languages, but it was [Sancier and Fowler 1997].

- **Portuguese /p t/:** influenced by English long-lag voiceless (not voiced) stops.
French-English bilinguals’ production of French /t/:

- French /t/: influenced by English long-lag /t/ (not /d/)
  [Flege 1987]

**Figure 1.** The mean voice onset time, in ms, in tokens of /t/ in *tous* (■) and *two* (□) by the L2 learners in four groups (represented by bars) and by monolingual native speakers of English and French (represented by horizontal lines). Most means are based on 70 observations (7 subjects × 2 conditions × 5 replicate tokens); the brackets enclose ±1 standard deviation.
Phonemic adaptation of vowels

Figure 1
Diagram of the formants for English and Quebec French vowels

[LaCharité and Paradis 2005]
Phonemic adaptation of vowels

English /ɪ, ʊ/ > Quebec French /i, u/ (not /e, o/).

(11) Examples of the adaptation of English /ɪ/ and /ʊ/ to /i/ and /u/ in Quebec French

<table>
<thead>
<tr>
<th>English</th>
<th>IPA</th>
<th>QF</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɪ/</td>
<td>clipper</td>
<td>[klɪpər]</td>
</tr>
<tr>
<td></td>
<td>(to) drill</td>
<td>[dɹɪl]</td>
</tr>
<tr>
<td></td>
<td>hippie</td>
<td>[hɪpi]</td>
</tr>
<tr>
<td></td>
<td>gyprock</td>
<td>[dʒɪpɹk]</td>
</tr>
<tr>
<td>/ʊ/</td>
<td>push up</td>
<td>[pʊʃap]</td>
</tr>
<tr>
<td></td>
<td>woofer</td>
<td>[wʊfɹɾ]</td>
</tr>
<tr>
<td></td>
<td>(to) book</td>
<td>[bʊk]</td>
</tr>
<tr>
<td></td>
<td>pusher</td>
<td>[pʊʃəɾ]</td>
</tr>
</tbody>
</table>

[LaCharité and Paradis 2005]
Phonemic adaptation of sonorant consonants

English /ɹ/ > Japanese /r/ (not /w/).

(23) Examples of the treatment of onset /ɹ/ ([ɹ]) in English loanwords in Japanese

<table>
<thead>
<tr>
<th>English</th>
<th>Japanese</th>
<th>Phonetic Approximation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. race</td>
<td>[ɾes] → [ɾes:u] *[wes:u]</td>
<td></td>
</tr>
<tr>
<td>b. rock</td>
<td>[ɾak] → [ɾok:u] *[wok:u]</td>
<td></td>
</tr>
<tr>
<td>c. cherry</td>
<td>[tʃɛɾi] → [tʃɛɾi:] *[tʃɛwi:]</td>
<td></td>
</tr>
<tr>
<td>d. truck</td>
<td>[tɾæk] → [tɔɾak:u] *[tɔwak:u]</td>
<td></td>
</tr>
<tr>
<td>e. scrap</td>
<td>[skɾæp] → [sukwɾap:u] *[sukwwap:u]</td>
<td></td>
</tr>
</tbody>
</table>

[LaCharité and Paradis 2005]
Phonemic adaptation of obstruent consonants

English /b d g/ > Mexican Spanish /b d g/ (not /p t k/).

(26) Statistics on the treatment of voiced onset stops in English loanwords in Mexican Spanish

<table>
<thead>
<tr>
<th></th>
<th>/b/</th>
<th>/d/</th>
<th>/g/</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cases</td>
<td>289</td>
<td>161</td>
<td>116</td>
<td>566</td>
</tr>
<tr>
<td>Phonetic approximation cases (devoicing)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Same phoneme cases</td>
<td>289</td>
<td>161</td>
<td>115</td>
<td>565</td>
</tr>
<tr>
<td>(100%) (100%) (99.1%) (99.8%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion cases</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(0.9%) (0.2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cases</td>
<td>394</td>
<td>229</td>
<td>179</td>
<td>802</td>
</tr>
<tr>
<td>Phonetic approximation cases (devoicing)</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Same phoneme cases</td>
<td>393</td>
<td>226</td>
<td>179</td>
<td>798</td>
</tr>
<tr>
<td>(99.7%) (98.7%) (100%) (99.5%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion cases</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>(0.3%) (0.4%) (0.2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[LaCharité and Paradis 2005]
Phonemic adaptation of obstruent consonants

English /b d g/ > Mexican Spanish /b d g/ (not /p t k/).

(27) Examples of unchanged voiced stops in English loanwords in Mexican Spanish

<table>
<thead>
<tr>
<th>English</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>/b/</td>
<td>[bɹɫ] → [bɹ] * [par]</td>
</tr>
<tr>
<td>bar</td>
<td>[bɹɫ] → [bɹ] * [par]</td>
</tr>
<tr>
<td>baseball</td>
<td>[bɛsˈbɔl] → [bɛsˈbɔl] * [pesˈpɔl]</td>
</tr>
<tr>
<td>/d/</td>
<td>[dɪp] → [dɪp] * [tɪp]</td>
</tr>
<tr>
<td>dip</td>
<td>[dɪp] → [dɪp] * [tɪp]</td>
</tr>
<tr>
<td>darling</td>
<td>[ˈdɑɹlin] → [ˈdɑɹlin] * [ˈtɑɹlin]</td>
</tr>
<tr>
<td>/ɡ/</td>
<td>[ɡɔɫf] → [ɡɔɫf] * [kɔɫf]</td>
</tr>
<tr>
<td>golf</td>
<td>[ɡɔɫf] → [ɡɔɫf] * [kɔɫf]</td>
</tr>
<tr>
<td>gang</td>
<td>[ɡæŋ] → [ɡæŋ] * [kɑŋ]</td>
</tr>
</tbody>
</table>

[LaCharité and Paradis 2005]
Phonemic adaptation of obstruent consonants

English /p t k/ > Burmese /p t k/ (not /pʰ tʰ kʰ/).

Table 4. Corpus figures for adaptations of aspirated stop allophones

<table>
<thead>
<tr>
<th>INPUT</th>
<th>n</th>
<th>UNASPIRATED</th>
<th>ASPIRATED</th>
<th>% UNASPIRATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>[pʰ]</td>
<td>21</td>
<td>21</td>
<td>0</td>
<td>100.0 %</td>
</tr>
<tr>
<td>[tʰ]</td>
<td>17</td>
<td>15</td>
<td>2</td>
<td>88.2 %</td>
</tr>
<tr>
<td>[kʰ]</td>
<td>36</td>
<td>34</td>
<td>2</td>
<td>94.4 %</td>
</tr>
</tbody>
</table>

[Chang - to appear]
Phonemic adaptation of obstruent consonants

English /p t k/ > Burmese /p t k/ (not /pʰ tʰ kʰ/).

(1)  
   a.  penguin > [pʰ.ɡwɨ]  
   c.  plastic > [pə.laʔ.sə.tuʔ]  
   e.  Japan > [dʒə.pəʔ]  
   g.  champagne > [ʃə.pəʔ]  
   b.  Poland > [pə.ˈlэiʔ]  
   d.  police > [pə.ˈlэiʔ]  
   f.  computer > [kəʊ.ˈpjuː.tə]  
   h.  ball pen > [bə.ˈpɛn]

[Chang - to appear]
Phonemic adaptation of obstruent consonants

English /p t k/ → Burmese /p t k/ (not /pʰ tʰ kʰ/).

**Figure 1.** Maintenance of source phonemic distinctions in adaptation

![Diagram showing phonemic adaptation]

[Chang - to appear]
Integrating phonetic and phonemic information

Privileged Status of Phonemics:
- When phonemic information is available, it tends to outrank conflicting phonetic information.
- Late L2 learners differ significantly from naive non-natives.

Malleability of Phonological Similarity:
- How is L1-L2 similarity initially determined in L2 learning?
- How does perceived L1-L2 similarity change over the course of L2 learning?
Tracking influence of phonemic information

If L2 sounds undergo automatic EQUIVALENCE CLASSIFICATION with L1 sounds: [Flege 1995]

- Beginning L2 learners must link L1 and L2 sounds on the basis of low-level information.

- Advanced L2 learners may link L1 and L2 sounds on the basis of higher-level information.

How does the changing level of cross-linguistic linkage influence the production and perception of L1 and L2 sounds? [Chang 2010]
Acknowledgements

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