Are markedness constraints universal?

Evidence from Mandarin Chinese speakers

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Introduction

- Are there **universal grammatical constraints** on the sound structure of language? **Optimality theory**[1] is a theory of universal grammar. It asserts that all grammars share a universal set of well-formedness conditions, called **Markedness constraints.** To the extent that these constraints are (a) universal and (b) active in early development, they could further help guide language acquisition. Here, we evaluate the universality hypothesis (a) by investigating the restrictions of sonority.
  - With the **sonority** scale, we can compute the **sonority distance (ΔS)** for onset clusters (e.g., ***bl****ock)* using $\Delta S = S_2 - S_1$. Linguistic theory predicts that small sonority distances are marked relative to larger distances.
    - Markedness scale for onset clusters: *lb* > *bd* > *bn* > *bl*

Onset cluster	Sonority level of C1 (S_1)	Sonority level of C2 (S_2)	ΔS	Sonority profile of onset
blif	1	4	3	Large rise
bnif	1	3	2	Small rise
bdif	1	1	0	Plateau
lbif	4	1	-3	Fall

(Markedness ↓)

  - **Sonority and grammatical universals:** According to Optimality theory, markedness constraints are universally active. All speakers disfavor *lb* to *bl*, even if both clusters are unattested in their language.
  - **Support from past research:** Results suggest that unmarked phonological structures are favored in English, Spanish, and Korean (preference: *bl* > *bn* > *bd* > *lb*), even when such clusters are unattested in these languages[2]-[4].
  - **Concern:** English, Spanish and Korean are relatively rich in clusters. Are these grammatical preferences active even in languages that allow few clusters of any kind?
- **Mandarin Chinese** only allows consonant-glide onsets (e.g., ***by****an, "change"*). In addition, only nasal-consonant clusters are allowed across syllables (e.g., **a****lb****um*).
  - **Support from Mandarin Chinese research:** Past research[5] suggest that Mandarin speakers favor *bl* over *lb*.
- **Question: Are Mandarin Chinese speakers sensitive to the entire sonority hierarchy?**
- **Prediction**: If marked structures are banned by the grammar, then as markedness increases, onsets are more likely to undergo repair (e.g., *lb* -> *leb*) [6], hence, their identification should decline.

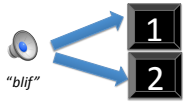
Experiment 1

- **Materials:**
  - 90 monosyllable (*blif*) + 90 disyllabic counterparts (*belif*)
  - 4 onset cluster types of monosyllables:
    - large sonority rise
    - small sonority rise
    - sonority plateau
    - sonority fall

Types	Monosyllable	Disyllable
Large rise	**bl**if	belif
Small rise	**bn**if	benif
Plateau	**bd**if	bedif
Fall	**lb**if	lebif

(Markedness ↓)

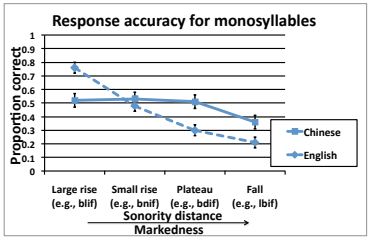
  - Auditory items, recorded by a speaker of Russian (in which all types of onset clusters are attested).
- **Participants:** 16 native Chinese speakers and 16 native English speakers, students from NEU
- **Procedure:** "short" or "long" judgment task

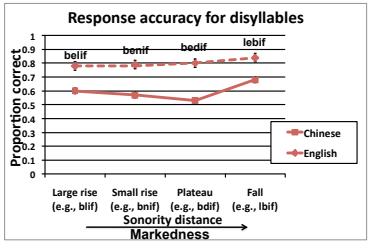


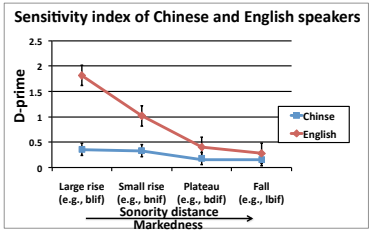
(= short, "*blif*")

(= long, "*belif*")

- **Results:**







- English speakers: *bl* > *bn* > {*bd, lb*}
- Chinese speakers are not sensitive to markedness at all.
- **Possible explanations:**
  - No universal grammar.
  - Phonetic factors masked the effect of sonority.
- **Test:** Last predictor stepwise regression.

	Chinese speakers		English speakers	
	ACC	RT	ACC	RT
Phonetic factors (burst intensity and duration)	(R^2 = 0.171)**	(R^2 = 0.007) n.s.	(R^2 = 0.031) n.s.	(R^2 = 0.132)**
Onset type	(R^2 = 0.001) n.s.	(R^2 = 0.010) n.s.	(R^2 = 0.501)**	(R^2 = 0.103)**

(n.s. – not significant, m.s. – marginal significant, * – p < 0.05, ** – p < 0.01)

- **Conclusion:**
  - Chinese speakers' sensitivity of sonority hierarchy was masked by phonetic cues.

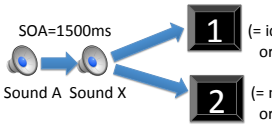
Experiment 2

- **Rationale:**
  - AX judgment attenuates the effect of phonetic factors (because burst release was roughly matched), sonority effect would be expected to emerge.
    - b^{XI}lif vs. b^{XI}elif
  - If ill-formed $C_1C_2VC_3$ are repaired as C_1eC_2VC, then $C_1C_2VC_3$ and $C_1eC_2VC_3$ should be realized as identical.
- **Materials:**
  - 120 pairs in each list: arranged in identical/non-identical pairs
  - 4 onset types of monosyllables

IDENTICAL PAIRS		
Types	**Monosyllable**	**Disyllable**
Large rise	blif-blif	belif-belif
Small rise	bnif-bnif	benif-benif
Plateau	bdif-bdif	bedif-bedif
Fall	lbif-lbif	lebif-lebif

NON-IDENTICAL PAIRS		
Types		
Large rise	blif-belif	belif-blif
Small rise	bnif-benif	benif-bnif
Plateau	bdif-bedif	bedif-bdif
Fall	lbif-lebif	lebif-lbif

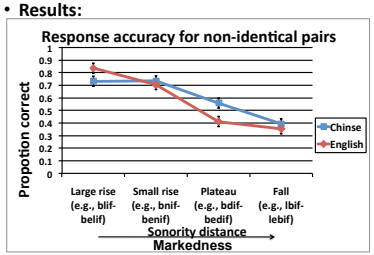
- **Participants:** another 16 native speakers in each group.
- **Procedure:** identity judgment task

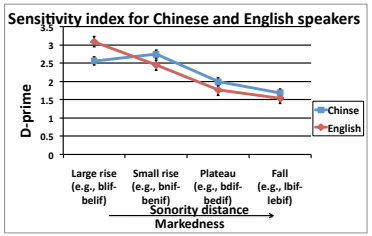


(= iden, "blif-blif" or "belif-belif")

(= non-iden, "blif-belif" or "belif-blif")

- **Results:**





- English speakers: *bl* > *bn* > {*bd, lb*}
- Chinese speakers: {*bl, bn*} > *bd* > *lb*
- **Test:** Last predictor stepwise regression.

	Chinese speakers		English speakers	
	ACC	RT	ACC	RT
Phonetic factors (burst intensity and duration)	(R^2 = 0.082)*	(R^2 = 0.014) n.s.	(R^2 = 0.045)*	(R^2 = 0.103)**
Onset type	(R^2 = 0.075)*	(R^2 = 0.048)*	(R^2 = 0.447)**	(R^2 = 0.038) m.s. (p=0.054)

(n.s. – not significant, m.s. – marginal significant, * – p < 0.05, ** – p < 0.01)

- **Conclusion:**
  - Chinese speakers' sensitivity to sonority hierarchy remained when phonetic factors are controlled.

General Conclusion

- Universal grammatical sonority constraints are apparently active in Mandarin, but they might be masked by the phonetic difficulties of Chinese speakers (Exp. 1).

[1] Prince, A., & Smolensky, P. (1993/2004). *Optimality theory: Constraint interaction ingenerative grammar. Malden, MA: Blackwell Pub.*
[2] Berernt, I., Lennertz, T., & Balaban, E. (2011). Language universals and misidentification: A two way street. Manuscript submitted for publication.
[3] Barlow, J. A. (2005). Sonority Effects in the Production of Consonant Clusters by Spanish-Speaking Children. In D. Eddington (Ed.), Selected Proceedings of the 6th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages (pp. 1- 14). Somerville, MA: Cascadilla Proceedings Project.
[4] Berent, I., Lennertz, T., Jun, J., Moreno, M. A., & Smolensky, P. (2008). Language universals in human brains. *Proceedings of the National Academy of Sciences, 105, 5321-5325.*
[5] Ren, J., Gao, L., & James, L. (2010). Mandarin speakers knowledge of the sonority sequencing principle. In 20th Colloquium on Generative Grammar, University of Pompeu Fabra, Barcelona.
[6] Berent, I., Steriade, D., Lennertz, T., & Vaknin, V. (2007). What we know about what we have never heard: Evidence from perceptual illusions. Cognition, 104(3), 591–630.

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