

Underlying Representations that do not Minimize Grammatical “Violations”

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Overview We provide evidence that speakers may construct underlying representations that are more abstract than is predicted by Lexicon Optimization (LO; as defined in (1)), a procedure by which underlying forms are selected so as to minimize grammatical violations.

- (1) *Lexicon Optimization* (Inkelas 1994, cf. also Prince & Smolensky 1993/2002:209)

“Given a grammar G and a set $S = \{S_1, S_2, \dots S_i\}$ of surface phonetic forms for a morpheme M , suppose that there is a set of inputs $I = \{I_1, I_2, \dots I_j\}$, each of whose members has a set of surface realizations equivalent to S . There is some I_i in I such that the mapping between I_i and the members of S is the most harmonic with respect to G , i.e. incurs the fewest marks for the highest ranked constraints. The learner should choose I_i as the underlying representation for M .” (cf. also Burzio (2000:55): “It is easy to see that (...) the actual input *equals* the actual output.”)

Consider Turkish stem-final obstruents. According to Inkelas, in cases where such obstruents alternate (surfacing as voiced before voiced sounds and voiceless elsewhere, e.g. [tat] ‘taste’ ~ acc. [tadI]), they are underlyingly adapted as voiced (here /tad/). The basic idea is that if [tadI] were underlyingly represented with a voiceless stem-final obstruent, faithfulness would be needlessly violated, hence learners construct /tad/ as the UR. The scenario is illustrated below; clearly /tad/ is a better choice of UR here.

/tat/+I	*Voiced-Coda	Ident-Voice
✗ [tati]		
☞ [tadi]		*
/tad/+I	*Voiced-Coda	Ident-Voice
☞ [tadi]		
[tati]		*

However, when only a single surface form is encountered (e.g., [tat] only), i.e., in cases of non-alternation or learning based on incomplete input, the prediction of LO is that learners will invariably choose the voiceless underlying representation. This prediction is challenged by the results of *deneutralization* studies, which reveal that speakers postulate more abstract URs for ambiguous (i.e. neutralized) surface forms under certain conditions. As Yip (1996) and Krämer (2005) point out, there are traditionally four economy principles used in constructing URs: economy of individual lexical entries, economy of phoneme inventories, economy of phonotactic combinations and economy of paradigms. In addition, we suggest that factors involved in justifying departures from SRs in constructing URs may include orthographic knowledge, Bayesian inference over lexical entries, and morpheme structure conditions.

We proceed to examine five deneutralization phenomena that provide evidence against Lexicon Optimization as the sole principle in UR construction.

English vowel reduction A simple case results from *-ian* affixation, which shifts stress to the immediately preceding syllable, even if it was a reduced vowel, e.g. [Wáshingtən] becomes [Washingtónian]. The prediction of LO is that the underlying vowel is a central vowel, so under stress, it should become something like [Washingtánian]. Clearly, speakers are using more than a “violation optimization” strategy here; in this case, they are relying on their knowledge of the orthographic representation (Michaels 1980).

English velar softening An additional deneutralization case in English comes from the backformation study of Pierrehumbert (2002), who examined the rule of velar softening with Latinate suffixes. Given nonce abstract nouns like hova[s]ity, when asked to produce the adjective that corresponds in meaning, some of her subjects produced [hovæk]. LO wrongly predicts that in the absence of alternations with these nonce forms, and in the absence of evidence for the $k \sim s$ alternation being fully productive, speakers should invariably select the UR /hovæs/.

Korean coronal fortition Korean is unusual in neutralizing a wide range of underlying coronal consonants such as /s/ to [t] in coda position, while simultaneously avoiding URs with /t/ in this position (Kang 2002). The problem for LO comes from cases such as the following: when Korean speakers are presented with the surface form [intənɐt-I] ‘Internet-Nom.’, they assign it the underlying form /intənes/ (Hayes 1998, Iverson & Lee 2004). There is no reason they should be doing this if “there are no constraints on underlying representations” beyond “minimizing constraint violation in the I-O mapping”: Korean speakers should assign the UR /intənɐt/ under the LO account, counter to fact.

Turkish final devoicing and prothesis As Lewis (1967:11) observes, Turkish has formed a productive lexical generalization that it employs when incorporating new loanwords: all polysyllabic forms that have a voiceless obstruent when word-final will have a voiced one when suffixed; i.e. polysyllabic loanwords will be adapted as underlyingly voiced for stem-final obstruents. Inkelas, Pycha, and Sprouse (2004) discuss the converse effect for monosyllables: they are adapted as underlyingly voiceless. This latter pattern is presumably the result of generalization over from the original statistical distribution of underlying final voiced and voiceless obstruents: the Turkish Electronic Living Lexicon reveals 145 monosyllables with a final voiceless stop, but only 19 monosyllables with a final voiced stop. Consider now the adaptation of “group” vs. “tube”. The former requires epenthesis due to the complex onset, yielding a polysyllabic form to which speakers attribute the UR /gurub/, yielding pairs such as [gurub~gurubu]. The latter is adapted as underlyingly /tüp/, yielding pairs such as [tüp~tüpu]. This pattern of UR postulation is consistent with statistical inference of Morpheme Structure Constraints but inconsistent with LO, which predicts that “group” and “tube” yield minimal faithfulness violations if adapted as /gurup/ and /tüb/, the exact opposite of what happens.

A related point comes from loanwords such as *stop*, which surface as [istop~istopu]. Based on the mono/polysyllabic generalization above, we can tell that this form is underlyingly /stop/, hence underlyingly voiceless-final. The prediction of LO is that there will be a vacuous surface~underlying mapping, i.e. that the UR will be something like /istop/ in order to avoid Dep violations. But given the pattern of MSCs above, we can infer that the UR does not contain the prothetic syllable, and that epenthesis is an effect of the grammar i.e., in OT terms, the UR-PR mapping results in constraint violation.

Lac Simon Algonquian initial devoicing This language has devoicing of obstruents in *initial* position, yielding neutralization (Kaye 1979). Underlyingly voiced pairs alternate as follows: [ka:zo:tim~niga:zo:tim] ‘3sg/1sg-hide’; cf. underlyingly voiceless [nikat] ‘1sg-leg’. The loanwords *coffee* and *banan* (French) are adapted as follows: [pa:na:n~niba:na:nim] ‘bare noun/1sg-banana’ and [ko:fi:ke~nigo:fi:ke] ‘3sg/1sg-make.coffee’. The adaptation of voiceless initial *coffee* as underlyingly voiced (as evidence by the 1sg) reveals that Lac Simon speakers are extracting lexical knowledge about the relation between underlying forms and alternations, and not relying simply on choosing a UR for coffee that is maximally faithful to its loanword input.

Alternative Models for UR Construction There are a wide variety of models that may be at play for what subjects are using to construct deneutralization, many of which do not suffer the pitfalls of LO. Eliasson (1993) and Ernestus & Baayen (2003) note that knowledge of the lexicon is essential in effectiveness in the type of ambiguity resolution which constitutes de-neutralization. Gallistel (2003) observes that when animals and humans have to solve problems with incomplete knowledge, as in the deneutralization situation described here, they use stochastic/probabilistic models to inform their decision. So, in a language with 70% surface final [t] and 30% surface final [d], underlying /t/ may be picked 70% of the time, in conformity with the surface, or 100% of the time, since it is the majority form. While the idea of a maximally transparent mapping between underlying form and surface form (“there are no restrictions or generalizations on inputs, except that they be constructed optimally from the point of view of grammar”) is a potentially nice idea, the facts of loanword adaptation and deneutralization explored here show that the human mind seeks statistical lexical regularities in the form of morpheme structure constraints,

and that there is more to constructing URs than minimizing constraint violation.

References

- Burzio, Luigi 2000. Cycles, Non-Derived-Environment Blocking, and Correspondence. In *Optimality Theory. Phonology, Syntax, and Acquisition*, ed. Joost Dekkers, Frank van der Leeuw and Jeroen van de Weijer, 47-87. Oxford: Oxford University Press.
- Eliasson, S. 1993. Cognitive processing of phonological ambiguity in second-language learning. *International Journal of Psycholinguistics* 9:2, 159-175.
- Ernestus & Baayen. 2003. Predicting the Unpredictable: Interpreting Neutralized Segments in Dutch.. *Language* 79:1, 5-38.
- Gallistel, C. R. 2003. Conditioning from an Information Processing Perspective. *Behavioral Processes* 61.3: 1234 1-13.
- Hayes, B. 1998. On the Richness of Paradigms, and the Insufficiency of Underlying Representations in Accounting for them. Lecture at Stanford University.
- Inkelas, S. 1994. The Consequences of Optimization for Underspecification. NELS 25. 287-302.
- Inkelas, S., A. Pycha, R. Sprouse. 2004. Morphophonemics and the Lexicon: A Case Study from Turkish. Paper presented at the Methods in Phonology ("Ohalafest") Workshop, Berkeley, CA.
- Iverson, G. & A. Lee. Perceived Syllable Structure in the Adaptation of Loanwords in Korean *Proceedings of the 2004 Linguistic Society of Korea International Conference (Vol. I: Forum Lectures and Workshops)*, pp. 117-136. Seoul: Hansin Publishing Co., 2004.
- Kang, Yoonjung. 2002. "Phonetic knowledge in loanword adaptation: adaptation of English word-final stops to Korean." Paper presented at the 76th Annual meeting of the Linguistic Society of America, San Francisco.
- Kaye, Jonathan. 1979. On the alleged correlation of markedness and rule function. In D. Dinnsen (ed.) *Current Approaches to Phonological Theory*, pp. 272-280, Indiana University Press, Bloomington.
- Krämer, M. 2005. Optimal Underlying Representations. NELS 35.
- Lewis, G.L. 1967. *Turkish Grammar*. Oxford: Clarendon.
- Michaels, David. 1980. Spelling and the phonology of tense vowels", *Language and Speech* 23: 197-225.
- Pierrehumbert 2002. An unnatural process. Labphon8, June 27-30, New Haven CT.
- Prince, A. & P. Smolensky. 1993/2002. Constraint Interaction in Generative Grammar.
- Yip, Moira 1996. Lexicon Optimization in Languages without Alternations. In *Current trends in phonology: Models and methods Vol. 2*, ed. Jacques Durand and Bernard Laks, 757-788. ESRI, University of Salford Publications, Salford.