Learning metathesis: Evidence for syllable structure constraints

Sara Finley *

Pacific Lutheran University, United States

ABSTRACT

One of the major questions in the cognitive science of language is whether the perceptual and phonological motivations for the rules and patterns that govern the sounds of language are a part of the psychological reality of grammatical representations. This question is particularly important in the study of phonological patterns – systematic constraints on the representation of sounds, because phonological patterns tend to be grounded in phonetic constraints. This paper focuses on phonological metathesis, which occurs when two adjacent sounds switch positions (e.g., *cast* pronounced as *cats*). While many cases of phonological metathesis appear to be motivated by constraints on syllable structure, it is possible that these metathesis patterns are merely artifacts of historical change, and do not represent the linguistic knowledge of the speaker (Blevins & Garrett, 1998). Participants who were exposed to a metathesis pattern that can be explained in terms of structural or perceptual improvement were less likely to generalize to metathesis patterns that did not show the same improvements. These results support a substantively biased theory in which phonological patterns are encoded in terms of structurally motivated constraints.

© 2016 Elsevier Inc. All rights reserved.

Introduction

One of the goals of the cognitive science of language is to understand the relationship between human cognition and the rules and patterns that are found across languages of the world. In the search for understanding this relationship, questions arise in regards to the extent to which patterns in languages are arbitrary, or are grounded in perceptual and cognitive principles. A phonological pattern is grounded if it can be explained in terms of phonetic grounding (e.g., increases the perceptibility of a word) or structural improvements (e.g., improves the syllable structure of a word), and is arbitrary if the pattern cannot be explained in these terms (Anderson, 1981).

On the one hand, linguistic patterns are typically analyzed using features and representations that are highly specific to language and language structure (e.g., vowel height) (Berent, Balaban, Lennertz, & Vaknin-Nusbaum, 2010; Goldsmith, 1993; Kiparsky, 1973), and include the structural improvements that result from the phonological rule/pattern (e.g., a reduction in markedness[1]) (Prince & Smolensky, 2004). On the other hand, linguistic patterns are often analyzed using highly abstract, symbolic constructions (e.g., reduplication as /AB/ → [ABAB]) (Chomsky & Halle, 1968). Phonological patterns can be considered abstract in two ways. First, phonological patterns refer to an 'underlying' form, or input, that may never be pronounced by a language user. Second, the representation makes use of symbols that include a wide range of elements (e.g., high vowels, or final position). The use of abstract

* Address: Department of Psychology, Pacific Lutheran University, 12180 Park Ave S, Tacoma, WA 98447, United States.
   E-mail address: finleysr@plu.edu

---

[1] Markedness is defined as the extent to which a phonological unit is dispreferred due to articulatory, perceptual and other cognitive constraints.

symbols opens the possibility for patterns to apply not only to linguistic units, but to non-linguistic units as well (Finley & Christiansen, 2011) (e.g., the element in final position is repeated). This raises the question as to whether symbolic rules are formed from general cognitive mechanisms, rather than from domain specific language generators (Chater & Christiansen, 2010; Monaghan, Chater, & Christiansen, 2005; Monaghan, Christiansen, & Chater, 2007), and whether the structural constraints that motivate linguistic patterns duplicates both domain-general cognitive constraints and considerations from language change, and therefore need not be included in the linguistic grammar (Blevins, 2004; Hale & Reiss, 2000). This issue is especially relevant for phonological patterns, which tend to be abstractions from more universal phonetic principles (Hyman, 1976). For this reason, this paper will focus on phonological patterns, specifically metathesis.

Phonological metathesis occurs when two adjacent sounds switch places (e.g., pronouncing '*cast*' as '*cats*', in which the /t/[2] and the /s/ switch).[3] Because many cases of metathesis are diachronic, or historical in nature, some cases of metathesis may appear to be arbitrary. Within the Metathesis in Language Database (Hume, 2016), several languages are listed as having no clear motivation,[4] either phonetic or phonological, and can be considered to be arbitrary. For example, in Georgian, the thematic suffix /-av/ metathesizes with sonorants, (e.g., /k'l + av/ → [k'vla] 'you kill them'), without any clear phonetic or phonological motivation (Hume, 2016).

Seemingly arbitrary patterns can also arise from the fact that metathesis involves abstract symbol manipulation (e.g., /A/ + /B/ → [BA]). Cases of 'mirror image' metathesis (Hume, 2004) in which one language shows one direction of metathesis (e.g., Hungarian, where /h/ metathesizes with /r/, /hr/ → [rh], as in /tehernek/ 'load-DAT' → [terhek], *[tehrek]'load-PL') and another language shows the opposite direction of metathesis (e.g., Pawnee, where /rh/ becomes [hr], /ti-ir-hisak-hus/ → [tihrisasku] 'he is called'), appear to be arbitrary because it is not clear what kind of perceptual or structural motivation could produce both directions of metathesis. Accounting for metathesis using abstract symbol manipulation allows for both directions of metathesis to occur (i.e., both /AB/ → [BA] and /BA/ → [AB]) without reference to structural or perceptual motivation.

While some cases of 'mirror image' metathesis appear to be arbitrary, other cases of 'mirror image' metathesis can be grounded in the perceptual constraints of the specific language. Because languages vary with respect to both the phonetic realization of sounds and syllable structure constraints, the optimal order of sounds may vary depending on how perceptual constraints interact in a given language. For example, Old English metathesis involves /sk/

becoming [ks] (e.g., /aske/ → [akse] 'ash') following a stressed syllable, while Colloquial French metathesis involves /ks/ becoming [sk] on the final, stressed syllable (e.g., /fiks/ → [fisk] 'fish'). Differences in stress assignment between these two languages result in differences in the perceptibility of /s/ word finally,[5] and result in 'mirror image' metathesis that is perceptually motivated by different language-specific perceptual constraints (Blevins & Garrett, 2004). Thus, even though the abstract symbols allow for both directions of metathesis to apply, phonetic and phonological constraints ground the phonological patterns, so that they are no longer arbitrary.

Hume (2004) argues that Optimality Theory (OT) (Prince & Smolensky, 2004) is ideal for accounting for perceptual and structural grounding of metathesis. In OT, language-specific differences are formalized as differences in constraint rankings. Markedness constraints govern the perceptual and structural makeup of a word. For example, *Coda is a formalization of the preference for onset consonants (the start of a syllable, as in [ba]) over coda consonants (the end of a syllable, as in [ab]). Faithfulness constraints, on the other hand, allow for violations of markedness constraints in favor of preserving the underlying form of a word. When markedness constraints outrank faithfulness constraints, structural changes occur, but when faithfulness constraints outrank markedness constraints, the underlying form is preserved. In order to induce metathesis, the markedness constraints that drive metathesis must outrank the faithfulness constraints that preserve the linear order of sounds in a word (i.e., Linearity). In languages with metathesis, Linearity must be ranked below the markedness constraints that motivate metathesis.[6] The result is that metathesis applies only when a markedness constraint would otherwise be violated; spurious metathesis would result in spurious violations of Linearity, and would therefore not be accepted in the language.

The OT analysis outlined above implies that metathesis cannot be arbitrary, but as noted above, there are cases of arbitrary metathesis. In OT, arbitrary patterns can be accounted for in a variety of ways, including 'ad hoc' constraints that target the specific pattern (Hayes, 1999). An ad hoc constraint for an arbitrary metathesis pattern might be something like 'Switch-CC', requiring consonants to change places from the input to the output. Because this kind of arbitrary, ad hoc constraint applies without structural considerations, metathesis applies more generally, regardless of whether metathesis results in structural improvements.

The existence of both grounded and arbitrary phonological processes poses the question of whether grounded patterns are privileged in terms of typology and learnability. According to the substantively biased theory of learning (Finley & Badecker, 2007; Wilson, 2006), language users

---

[2] Transcriptions of phonological forms are in IPA format.

[3] Note that for the purposes of this paper, only consonant-consonant metathesis is discussed, but languages do employ consonant-vowel metathesis (Blevins & Garrett, 1998).

[4] Note that the term 'motivation' is used to refer to the phonetic and structural pressures that drive metathesis. This term is used throughout the Metathesis Database (Hume, 2016).

[5] Final stress in French lengthens the /s/, increasing the confusability of the surrounding /k/ segment, so the /s/ is moved out of final position in order to preserve perceptibility of /k/.

[6] In the case of an artificial grammar learning experiment, this markedness constraint (e.g., Maximize Onsets) could be already learned or be learned during the course of the experiment. Both make the same prediction about generalizing to contexts that do not meet the structural requirements.