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On the unity of children's phonological error patterns: Distinguishing symptoms from the problem

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Abstract
This article compares the claims of rule- and constraint-based accounts of three seemingly distinct error patterns, namely, Deaffrication, Consonant Harmony and Assibilation, in the sound system of a child with a phonological delay. It is argued that these error patterns are not separate problems, but rather are symptoms of a larger conspiracy to avoid word-initial coronal stops. The clinical implications of these findings are also considered.

Keywords: *optimality theory, rules, conspiracy, phonological delay*

Introduction

It has long been recognized that the characterization of children's phonological error patterns as rules or natural processes advanced our understanding of developing sound systems and aided the clinical assessment and treatment of phonological disorders. These rules have revealed systematic sound patterns, context effects and intricate relationships among sounds and other processes by expressing generalizations about what is impermissible in the child's sound system and specifying how the child repairs those illicit structures. To the extent that children internalize target-appropriate underlying representations, as is widely assumed, each rule has served to define a phonological problem. From a clinical perspective, identification of persistent or unusual processes has been useful for diagnosis and the selection of treatment targets. For example, to address the common problem of a child's replacement of affricates with a simple alveolar stop, a Deaffrication rule might have been proposed that was defined to operate on underlying affricates with the specified repair being a simple stop consonant. Treatment might, then, have been aimed at the suppression of that process by focusing the child's attention on the occurrence of minimal pairs that contrasted affricates (the rule's input) with simple alveolar stops (the rule's output, e.g. 'chew' vs. 'two').

More recently, however, the framework of optimality theory (e.g. Prince and Smolensky, 1993/2004) has been advanced as an alternative to these rule-based accounts, arguing that rules are unnecessary and, in fact, miss significant generalizations. Some of the most

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compelling evidence in support of this newer framework came from the discovery of phonological 'conspiracies' in fully developed languages. A conspiracy is typified by multiple processes working together in a language to achieve the same end. Inasmuch as rule-based theories have no mechanism for unifying the rules that participate in a conspiracy, that larger generalization goes unstated. The challenge that this poses for basic and applied research on acquisition is that reliance on rules may simply provide us with a collective description of symptoms, rather than pinpointing the basic source of the problem.

While the consequences of optimality theory for the characterization of children's error patterns have received a good deal of attention on several fronts (e.g. Bernhardt and Stemberger, 1998; Kager, Pater and Zonneveld, 2004; Dinnsen and Gierut, 2008), surprisingly little attention has been given to developmental conspiracies and even less to their clinical implications. Most of the conspiracies that have come to light in young children's developing phonologies have centred around various repairs for consonant clusters (e.g. Pater and Barlow, 2003). This article presents evidence of a different, previously unnoticed conspiracy in the sound system of a child with a phonological delay and contrasts a rule-based and optimality theoretic account of the facts with consideration given to the differing clinical implications of those accounts.

The Facts of the Case and a Rule-Based Account

Consider the data in (1) from a child with a phonological delay, Child 126 (age 3 years; 11 months), who was selected for illustration purposes from the Developmental Phonology Archive of the Learnability Project at Indiana University. For details about the project, participants, testing and analyses, see Dinnsen and Gierut (2008). This child exhibited three seemingly independent processes or rules of special interest. As illustrated in (1a), word-initial affricates were disallowed in this child's inventory and underwent a process of Deaffrication, resulting in the substitution of a coronal fricative. While it is perhaps more common for children to replace affricates with a simple alveolar stop, we will see that that particular repair was not viable on other grounds. The forms in (1b) evidence another common process, Consonant Harmony, which caused coronal stops to assimilate to the place of articulation of a following dorsal consonant. A third process of Assibilation, exemplified in (1c), changed all remaining word-initial coronal stops to a sibilant. Post-vocalic coronal stops (including affricates) were unaffected by these processes. While the observed merger of place and manner distinctions in word-initial position might be considered unusual from the perspective of fully developed languages, it has been argued based on evidence from young children's developing phonologies (normal and disordered) that word-initial position represents a phonologically weak context, at least in the early stages of development, and is thus vulnerable to such mergers (e.g. Dinnsen and Farris-Trimble, 2008). In rule-based terms, Deaffrication must be ordered before Consonant Harmony to prevent affricates (which are coronal stops) from undergoing Consonant Harmony (cf. the forms in the right-hand column of (1a)). Consonant Harmony must, in turn, be ordered before Assibilation to prevent coronal stops from undergoing Assibilation in assimilatory contexts (cf. the forms in (1b)).

(1) Child 126 (age 3;11)

a. Deaffrication

[sɛʊ]	'chair'	[sɪkɪn]	'chicken'
[sɪp]	'chip'	[sɔk]	'chalk'
[siz]	'cheese'	[sik]	'cheek'

[zɛʊ] 'jail' [z̥ækɪt] 'jacket'
[zip] 'jeep' [zoʊkin] 'joking'

b. Consonant Harmony
[kaɪgoʊ] 'tiger' [gɑg] 'dog'
[kɪkɪt] 'ticket' [gʌk] 'duck'
[kɪkɪn] 'ticking' [gɪgɪŋ] 'digging'

c. Assibilation
[saɪ] 'tie' [sɑp] 'top'
[seɪp] 'tape' [soʊz] 'toes'
[sɛʊ] 'tail' [sis] 'teeth'

Note that all three of the above processes effected changes in word-initial coronal stops. Despite this commonality, the fact that these coronal stops changed to a dorsal consonant under certain circumstances and a coronal fricative under others makes it formally impossible to conflate these rules under the single, unifying generalization that all word-initial coronal stops were prohibited in this child's phonology. While this generalization might have been inferable from an informal inspection of the rules, there is no reason in a rule-based theory to expect these processes to have co-occurred or to have had the particular effects they did. In addition, because rules are generally assumed to be independent of one another, different treatment options (i.e. different minimal pairs) would have been called for to suppress each of the specific rules (e.g. 'chew'/'Sue', 'choke'/'soak', 'take'/'cake', 'two'/'Sue'). Similarly, treatment aimed at the suppression of any one of the individual rules should have no necessary impact on any of the other rules. Finally, if a rule-based account had been able to capture the larger generalization about the ban on word-initial coronal stops, an explanation would have been available for why Deaffrication yielded a fricative, rather than the more typical repair with a coronal stop. That is, if Deaffrication had yielded a simple coronal stop, that output would have, contrary to fact, resulted in an exception to Consonant Harmony and/or Assibilation. The empirically attested result was, however, that the interaction of these processes yielded perfectly transparent, surface-true (exceptionless) generalizations.

An Optimality Theoretic Account

A situation of the sort described above constitutes a classic instance of a conspiracy and is readily amenable to an optimality theoretic account that employs a small set of ranked universal constraints. To capture the unifying generalization that accounts for the different responses to these processes, we will need to appeal to the constraints and constraint hierarchy in (2). The markedness constraints assign violation marks to output candidates that include marked structures such as complex segments (i.e. affricates), fricatives and different consonantal places of articulation. The antagonistic faithfulness constraints assign violation marks to output candidates that fail to preserve a specific place or manner feature of the corresponding underlying input representations. The ranking of these constraints establishes a metric for evaluating the seriousness of constraint violations. Candidates that violate highly ranked constraints are eliminated from the competition, favouring the candidate with the least serious violations. Markedness constraints are assumed to be ranked above faithfulness constraints in the initial state, with learning proceeding by the demotion of markedness constraints based on positive evidence (e.g. Smolensky, 1996). The fact that Child 126 produced dorsal consonants and coronal fricatives target-appropriately in word-initial position reflects the fact that

*DORSAL and *FRIC had already been demoted below ID[dor] and ID[cont], respectively. The ranking of *#CMPLSEG and *#t over ID[cont] and ID[cor] corresponds with the undominated default ranking of markedness over faithfulness and the fact that those markedness constraints were never violated by a winning candidate. ID[dor] is also undominated as evidenced by the fact that it was never violated and dorsal consonants served as triggers of Consonant Harmony. While coronal consonants are relatively unmarked, their vulnerability to change follows from the interleaving of faithfulness and markedness constraints related to harmonic scales involving place of articulation (e.g. de Lacy, 2006).

(2) Constraints

a. Markedness
*#CMPLSEG: Word-initial complex segments (i.e. affricates) are banned
*#t: Word-initial coronal stops are banned
*DORSAL: Dorsal consonants are banned
*FRIC: Fricatives are banned

b. Faithfulness
ID[dor]: Corresponding segments must preserve the input feature [dorsal]
ID[cor]: Corresponding segments must preserve the input feature [coronal]
ID[cont]: Corresponding segments must preserve the input feature [continuant]

c. Ranking
*#CMPLSEG, *#t, ID[dor] >> ID[cor], ID[cont], *DORSAL >> *FRIC

The following tableaux show how optimality theory accounts for the various processes associated with this child's conspiracy. For expository purposes, we have limited the candidate set to the most likely competitors, and we assume throughout, consistent with richness of the base (e.g. Smolensky, 1996), that this child could have internalized target-appropriate underlying representations. The important point here is that the constraint hierarchy must achieve the empirically observed output, no matter what might be assumed about children's underlying representations.

The process of Deaffrication is exemplified in (3). The fully faithful candidate (a) is eliminated due to its fatal violation of undominated *#CMPLSEG (and *#t). Note too that the more typical simple stop substitute for an affricate (candidate (b)) is eliminated by its violation of the other undominated markedness constraint *#t. The two remaining candidates both violate ID[cont] due to their failure to preserve either the stop or the fricative portion of the affricate. Candidate (d) with the dorsal stop substitute incurs additional violations from ID[cor] and *DORSAL, either one of which causes candidate (d) to be eliminated from the competition. This renders candidate (c) with a coronal fricative as the optimal (preferred) output for a word-initial affricate.

(3) Deaffrication

/tʃɪp/	'chip'	*#CMPLSEG	*#t	ID[dor]	ID[cor]	ID[cont]	*DORSAL	*FRIC
a.	[tʃɪp]	*!	*					
b.	[tɪp]		*!			*		
c. ☞	[sɪp]					*		*
d.	[kɪp]				*	*	*!	

Our account of Assibilation for words beginning with a simple coronal stop is given in (4). The fully faithful candidate (a) is immediately disposed of due to its violation of undominated *#t. While candidates (b) and (c) each violates one of the lower ranked faithfulness constraints, the added violation of *DORSAL incurred by candidate (c) eliminates that candidate in favour of the winner, namely candidate (b) with a coronal fricative.

(4) Assibilation

/taɪ/ 'tie'	*#CMPLSEG	*#t	ID[dor]	ID[cor]	ID[cont]	*DORSAL	*FRIC
a. [taɪ]		*!					
b. ☞ [saɪ]					*		*
c. [kaɪ]				*		*!	

A novel aspect of our account is embodied in the explanation for Consonant Harmony. This process is generally thought to follow from a highly ranked markedness constraint that bans the occurrence of two different place features within the same word (e.g. Bernhardt and Stemberger, 1998). Note, however, that our account makes no reference to any such markedness constraint. If such a constraint existed in this child's grammar, it must have been low ranked (i.e. inconsequential) because multiple place features were obviously tolerated within a word. The tableau in (5) shows that Consonant Harmony does, nonetheless, follow quite naturally from a different source. The fully faithful candidate (a) with a word-initial coronal stop is eliminated due to its fatal violation of *#t. While candidates (b) and (c) represent phonetically identical outputs, they differ phonologically in their structural descriptions. Candidate (b) includes two separate dorsal consonants, resulting in one violation of ID[cor] and two violations of *DORSAL (i.e. one for each of the [dorsal] features associated with each consonant). Candidate (c), on the other hand, includes two dorsal consonants that are linked to one and the same [dorsal] feature, incurring one ID[cor] violation and just one *DORSAL violation. This leaves candidate (c) and the Assibilation candidate (d) to tie in the number of their violations, passing the choice to the lower ranked markedness constraint against fricatives. The harmonized candidate (c) is, thus, preferred over the assibilated candidate (d). This latter point also mirrors the blocking effect that Consonant Harmony has on Assibilation in harmonizing contexts. With the choice between candidates being made by the lower ranked markedness constraint *FRIC, Consonant Harmony would constitute a case of 'the emergence of the unmarked' (e.g. Prince and Smolensky, 1993/2004).

(5) Consonant Harmony

/tɪkɪt/ 'ticket'	*#CMPLSEG	*#t	ID[dor]	ID[cor]	ID[cont]	*DORSAL	*FRIC
a. [tɪkɪt] | [dorsal]		*!				*	
b. [kɪkɪt] / \\ [dorsal] [dorsal]				*		**!	
c. ☞ [kɪkɪt] \\/ [dorsal]				*		*	
d. [sɪkɪt] | [dorsal]					*	*	*!

The final tableau in (6) illustrates the interaction between Deaffrication and Consonant Harmony. The fully faithful candidate with an initial affricate fatally violates the undominated markedness constraints and can be set aside. Candidate (b) with a coronal stop also violates the undominated markedness constraint *#t, leaving us with two viable competitors, that is, candidates (c) and (d). Both of these candidates violate ID[cont] and *DORSAL, but the harmonized candidate (c) incurs an additional ID[cor] violation not incurred by candidate (d) with its coronal fricative. Consonant Harmony is, thus, blocked in this instance (even assuming just one [dorsal] feature linked to both consonants), favouring Deaffrication to a coronal fricative.

(6) Deaffrication blocks Consonant Harmony

/tʃɪkən/ 'chicken'	*#CMPLSEG	*#t	ID[dor]	ID[cor]	ID[cont]	*DORSAL	*FRIC
a. [tʃɪkən]	*!	*				*	
b. [tɪkən]		*!			*	*	
c. [kɪkən]				*	*	*!	
d. ☞ [sɪkən]					*	*	*

The clinical implications of our optimality theoretic account differ from those of a rule-based account. One of the main differences is that the process of Consonant Harmony was found to be an epiphenomenon or symptom of a larger problem, which centred around the highly ranked markedness constraint that banned word-initial coronal stops. As such, the prediction would be that there is no need to focus treatment specifically on the suppression of Consonant Harmony. Instead, the eradication of that process should follow from a treatment plan that focused on the suppression of one of the other processes. For example, treatment might be aimed at the suppression of Assibilation by demoting *#t below ID[cont]. This could be achieved by teaching the child minimal pairs that contrasted a simple coronal stop with a sibilant in a word-initial non-assimilatory context (e.g. 'two'/'Sue'). Another novel (and possibly preferable) treatment alternative might be to contrast a word-initial affricate with a simple coronal stop (e.g. 'chew'/'two'). Notice that this alternative would depart from conventional minimal pair treatment, which usually contrasts a target sound with its substitute. Under this plan, treatment would be aimed at the demotion of the two undominated markedness constraints and should introduce two new sounds (i.e. affricates and simple coronal stops) word-initially, effectively suppressing all three error patterns in one fell swoop. While these predictions must await experimental evaluation, they serve to illustrate some of the new and different insights that emerge from applying the principles of optimality theory to the description of phonological disorders.

Conclusion

This article identified three seemingly distinct error patterns that were argued to be symptomatic of a child's larger conspiracy to avoid coronal stops word-initially. While rule-based theories fail to capture the generalization behind such conspiracies, optimality theory provides a straightforward account with new and promising clinical implications.

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