On the nature of alternations in phonological acquisition*

Daniel A. Dinnsen and Laura W. McGarrity

Indiana University

Address correspondence to: Daniel A. Dinnsen
Department of Linguistics
Memorial Hall 322
1021 East Third Street
Indiana University
Bloomington, IN 47405

Phone: 812-855-7948; Fax: 812-855-5363
Email: dinnsen@indiana.edu

Submitted March 5, 2003; revised June 3, 2003
To appear in: *Studies in Phonetics, Phonology, & Morphology* 10: 23-41 (2004)

*Acknowledgments: We are especially grateful to Judith Gierut, John McCarthy, Ashley Farris, Steve Chin and Greg Iverson for their helpful comments on earlier versions of this paper. Some aspects of this work were presented at the 11th Manchester Phonology Meeting (May 2003). This work was supported in part by a grant from the National Institutes of Health DC-01694.

On the nature of alternations in phonological acquisition

Abstract

This paper brings first-language acquisition evidence to bear on a guiding principle of phonology, namely the Alternation Condition, and identifies some problems with its integration into both rule-based and constraint-based theories of phonology. It has long been held that neutralization rules apply only in derived environments and that no phonological rule can apply exclusively in a nonderived environment. Three problematic case studies are considered. In the first of these, a process is shown to apply exclusively in a nonderived environment. The second case involves a different process that is also restricted to a nonderived environment but requires an extended notion of what constitutes a (non)derived environment. The third case finds the same process to be restricted to a derived environment, but again requires the extended interpretation of (non)derived environments. Optimality theoretic accounts of these phenomena are formulated to take advantage of developmental changes in morphology and constraint rankings.

Keywords: alternations, acquisition, phonology, optimality theory

1. Introduction

One of the enduring insights of Generative phonology has been the Alternation Condition, which maintains that neutralization rules apply only in derived environments (Kiparsky 1976). A corollary of this principle is that no phonological rule can apply exclusively in a nonderived environment. Derived environments are created by the concatenation of morphemes or by the application of some other phonological rule. In the typical case of a derived environment, an illicit sequence is created by the final segment of one morpheme coming into contact with the initial segment of the next morpheme, triggering application of a rule. On the other hand, an example of a nonderived environment would be a tautomorphemic sequence of segments at the underlying level of representation. By its very nature, the internal composition of a nonderived environment is presumably stable and unchanging. If a neutralization rule were permitted to apply to a nonderived representation, the rule would apply to every instance of the morpheme, obliterating any evidence of the putative underlying distinction. Underlying distinctions that are absolutely neutralized in this way are judged as being highly abstract and thus unlearnable. While the Alternation Condition was formulated as a constraint on rule application, it ultimately had the effect of constraining the abstractness of underlying representations. The idea was that underlying distinctions that are postulated in nonderived environments need to be directly observable in order to be learnable. With this principle in place, highly abstract underlying representations are effectively precluded. On the other hand, underlying distinctions that might arise in derived environments tolerate change because they remain recoverable (nonabstract) in those contexts where the rule does not apply.

We will refer to the collection of these effects, namely the blocking or application of a rule in derived or nonderived environments, as derived environment effects. Such effects pose a number of challenges for optimality theory (Prince & Smolensky 1993/2002; McCarthy & Prince 1995; McCarthy 2002b). While there are no rules to apply or be blocked in optimality theory, the generalizations we might associate with rules are expressed instead by a constraint hierarchy. The expectation is that these generalizations will be surface-true or transparent. The problem is that derived environment effects involve generalizations that are opaque (i.e., not surface-true). For example, if a phonological generalization holds for a particular sequence of sounds that arises across a morpheme boundary but does not hold for the same sequence within a morpheme, the tautomorphemic sequence constitutes a superficial exception to the generalization. Several different proposals have been put forward to deal with these effects, including the local conjunction of constraints from different families (Łubowicz 1999, 2002), output-to-output correspondence (Benua 1995, 1997), and most recently comparative markedness (McCarthy 2002a). The connection of derived environment effects with restrictions on the abstractness of underlying representations also bears on a central tenet of optimality theory, namely richness of the base. The assumption is that there can be no language-specific restrictions on underlying representations. This means that highly abstract underlying representations must be tolerated.

While these issues have received much attention in the phonologies of fully developed languages, surprisingly little information is available about the nature of alternations and derived environment effects in phonological acquisition. The purpose of this paper is to bring acquisition evidence to bear on these issues, especially as they impact optimality theory. Toward this end, we will document various types of developmental derived environment effects.

All of these effects will be shown to pose a problem of one kind or another for conventional assumptions about the Alternation Condition and/or for its integration into optimality theory.

Data will be presented from three first-language learners of English. In §2, evidence will be presented relating to a process that is restricted to a nonderived environment. While problematic for rule-based frameworks, the facts will be accounted for within optimality theory by adopting conventional output-to-output correspondence constraints as employed in Benua (1995) (cf. Benua 1997) for underapplication effects in fully developed languages. In §3, evidence will be presented from another child with a different error pattern that is similarly restricted to a nonderived environment. The difference in this case is that the process results in an alternation that requires extending the notion of a (non)derived environment. A less conventional optimality theoretic account is argued for in this case. In §4, evidence is presented from another child with a different version of the prior error pattern. In this instance, the process is restricted to a derived environment, but requires our extended notion of a (non)derived environment. The optimality theoretic account for this child will illustrate ‘the emergence of the unmarked’. In §5, we conclude with a general discussion that compares the various accounts. The problem for optimality theory is that no one set of proposals provides a unified account of these effects. The more general problem is that the ultimate contribution of the Alternation Condition is called into question by richness of the base and by the greater than expected range of derived environment effects in both developing and fully developed languages.

2. A process restricted to nonderived environments without an alternation

In the celebrated study of Amahl (Smith 1973), an interesting phenomenon was identified that has been dubbed the 'puzzle-puddle-pickle problem' (cf. Macken 1980; Dinnsen et al. 2001; McCarthy 2002a). The problem involved two processes that interacted to yield the effect of a chain shift. The forms in (1) illustrate the relevant substitution patterns. One process (Stopping) accounted for the nonoccurrence of fricatives and their replacement by stops. Thus, 'puzzle' words were realized as 'puddle' words. The other process (Velarization) accounted for the change of coronal stops to velars before liquid laterals (both plain and syllabic), presumably as a result of assimilation to the dorsal articulation of /l/ (Smith 1973, p.14). Thus, 'puddle' words were realized as 'pickle' words. 'Pickle' words were realized target appropriately. Importantly, 'puzzle' words did not change to 'pickle' words.

(1) Amahl

a. *Puzzle* words realized as *puddle* words (Stopping)

pʌdl̩	'puzzle'
pɛntl̩	'pencil'
wɪtl̩	'whistle'

b. *Puddle* words realized as *pickle* words (Velarization)

pʌgl̩	'puddle'	æŋkləz	'antlers'
bɔkl̩	'bottle'	bʌklə	'butler'
hæŋgl̩	'handle'	trɔglə	'troddler'

c. *Pickle* words realized target appropriately

pɪkl̩ ‘pickle’

təːkl̩ ‘circle’

These results are easily achieved in derivational theories by ordering Velarization before Stopping in a counterfeeding relation. Chain shifts are acknowledged to require special attention in optimality theory and have resulted in various alternative proposals, including local constraint conjunction (Kirchner 1996; Moreton & Smolensky 2002), ternary feature scales (Gnanadesikan 1997), and comparative markedness (McCarthy 2002a). Chain shifts represent one type of derived environment effect in that a process (Velarization) is blocked from applying to a representation derived from another process (Stopping). Because any of the various proposals noted above can account for this type of phonologically derived environment effect, we will not concern ourselves further in this paper with chain shifts, except to note that chain shifts are among the derived environment effects that ultimately need to be accommodated and that chain shifts are quite common in acquisition (e.g., Dinnsen et al. 1997; Dinnsen & Barlow 1998; Dinnsen & O’Connor 2001).

There is, however, one very important fact about the puzzle-puddle-pickle problem that has received surprisingly little attention. That is, Smith (1973, p. 173) notes that the Velarization rule must be blocked from applying to a coronal stop + liquid sequence that arises across a morpheme boundary. The forms in (2) illustrate the failure of the Velarization rule to apply in morphologically derived environments.

(2) Velarization blocked in morphologically derived environments

Derived:		Base:	
kwæːtliː	‘quietly’	kwæːt	‘quiet’
sɔftliː	‘softly’	sɔft	‘soft’
haːdliː	‘hardly’	haːd	‘hard’
taitliː	‘tightly’	tait	‘tight’

It appears, then, that the Velarization process must be blocked both in phonologically derived environments (i.e., the counterfeeding chain shift) and in morphologically derived environments. This means that, contrary to general expectations, the Velarization rule applies only in nonderived environments. The real problem is achieving this effect without violating the Alternation Condition. This might be accomplished within rule-based theories by attributing the restriction to a morpheme structure condition (Halle 1959; Stanley 1967), effectively banning coronal stop + liquid sequences within a morpheme at the underlying level of representation (cf. Clayton 1976; McCarthy 1999). Because the Velarization process would not be a conventional phonological rule under this account, there would be nothing to prevent coronal stop + liquid sequences from arising across morpheme boundaries at the underlying level of representation and being realized as such at the phonetic level.[1] Something along these lines was actually proposed by Macken (1980) in her reanalysis of these and related facts. Under her account, the Velarization process more properly reflected a perceptual problem on Amahl’s part, resulting in his misrepresentation of certain morpheme-internal sequences at the underlying level of representation.

These acquisition facts would seem to undermine to some extent the contribution of the Alternation Condition. That is, we are able to retain what we think we know about principles of rule application and derived environment effects only if we first claim that there is no Velarization rule and restrict underlying representations to exclude the troublesome sequences in just those contexts where the application of the putative rule would otherwise pose a problem for the Alternation Condition. These facts are also relevant to optimality theory because richness of the base will not sanction a morpheme structure type of restriction that holds only at the underlying level of representation.

Optimality theory has available several options for achieving the results described above without violating richness of the base. Probably the most obvious of these is to invoke a crucial ranking among three different types of constraints, as in (3). The first of these constraints, OO-FAITH, is an output-to-output correspondence constraint that demands identity between the simple base form of a word and the morphologically related, derived counterpart of that word (e.g., Benua (1995)). The markedness constraint *dl is adapted from Dinnsen et al. (2001) and bans coronal stop + liquid sequences. Finally, IO-FAITH is a conventional faithfulness constraint that demands identity between an input representation and an output.

(3) Constraints and ranking

OO-FAITH: Every segment and every feature of the base must have an identical correspondent in the morphologically related form.

*dl: Avoid coronals before liquid consonants.

IO-FAITH: Every segment and every feature in the input must have an identical correspondent in the output.

Ranking: OO-FAITH >> *dl >> IO-FAITH

By ranking the markedness constraint over IO-FAITH, we can account for the Velarization error pattern and the nonoccurrence of coronal stop + liquid sequences, at least within a morpheme, independent of what might be assumed about the underlying representation of those sequences. Stated differently, the prohibition against coronal stop + liquid sequences is expressed by a conventional markedness constraint that is defined on output representations. It is thus unlike a morpheme structure condition or any other type of restriction that is specific to underlying representations. The tableau in (4) shows how the error pattern obtains for target 'puddle' words. Because we are dealing with a monomorph in this instance, OO-FAITH does not contribute to the evaluation of these candidates. The faithful candidate is eliminated by its violation of *dl. The target appropriate realization of 'pickle' words would be handled in much the same way.

(4) *Puddle* realized as *puggle*

puddle	OO-FAITH	*dl	IO-FAITH
a. pʌdl̩		*!	
b. ☞ pʌgl̩			*

By ranking OO-FAITH over *dl, we are claiming that it is more important for a morphologically related, derived form of a word to correspond to the base form of that word than it is for the derived word to comply with the markedness constraint. These two constraints conflict in just those cases where a coronal stop + liquid sequence would arise across a morpheme boundary (i.e., a morphologically derived environment). Compare the base form of the word 'quiet' with the morphologically related, derived form of that word 'quietly'. The assumption is that a derived word is composed of a base plus an affix. The formation of the base word alone ('quiet') is unaffected by *dl given that there is no liquid consonant in the base. Consequently, that portion of the derived word which includes the base will be realized faithfully with a coronal stop. The greater demand to comply with OO-FAITH compels a violation of *dl and selects the target appropriate candidate where Velarization is blocked as shown in (5).[2]

(5) No change in a derived environment

quietly	OO-FAITH	*dl	IO-FAITH
a. ☞ kwæ:tli:		*	
b. kwæ:kli:	*!		

It is equally possible to conceive of an alternative optimality theoretic account of these facts which adopts comparative markedness as formulated by McCarthy (2002a). However, a comparative markedness account of these and other morphologically derived environment effects depends on output-to-output correspondence to determine whether a markedness violation is 'old' or 'new' relative to the base. Something along the lines of our account above would thus be necessary in any event. It is less clear that comparative markedness is capable of accounting for the fuller set of case studies considered in this paper.

Summing up to this point, we have seen in the case of this typically developing child that a process can apply in a nonderived environment while also being blocked in a derived environment. Such a result is in conflict with various aspects of the Alternation Condition.[3] However, more traditional rule-based accounts can get around this problem and achieve these effects by claiming that there is no rule and restricting the underlying representations by means of a morpheme structure condition. Optimality theory can accept the validity of the Velarization process with its more restricted domain without violating richness of the base. Moreover, our account adopts constraints and a constraint hierarchy that is needed for other underapplication effects in fully developed languages (e.g., Benua 1995; McCarthy 2002).

Rules or processes are generally understood to involve alternations. Since the Velarization process described above was restricted to nonderived environments, it did not involve an alternation. It did, however, appeal to a conventional sense of what constitutes a derived environment. In the remainder of this paper, we will consider other processes that do result in an alternation. In one case, the process responsible for that alternation will be shown to be restricted to a nonderived environment (similar to what was observed for Amahl). In the other case, the process will be shown to be restricted to a derived environment. The more interesting aspect of these alternations is that they both require extending the notion of a (non)derived environment beyond conventional interpretations.

The two cases we will be considering below involve a Dentalization error pattern that is common in both typical and delayed phonological development (e.g., Smit 1993). In its most general form, this process replaces a late-acquired fricative such as /s, z/ with [θ, ð]. An especially interesting variety of this error pattern is illustrated by two children with phonological delays (Dinnsen & McGarrity 1999). While these two children were delayed in their phonological development, it is important to point out that they were typically developing in all other respects, scoring within normal limits on all tests of oral/motor, language and cognitive functioning.

3. A process restricted to nonderived environments with an alternation

The data in (6) from Child 33 (age 6;6) illustrate one variety of this Dentalization error pattern. It can be observed that the process applied in various contexts within the simple nonderived form of words but was blocked from applying in those same contexts within the morphologically more complex form of the same words. This alternation represents a rather novel notion of a (non)derived environment.

(6) Child 33 (6;6)

a. Stem:	Derived:	Gloss:	b. Stem:	Derived:	Gloss:
θʌn	sʌnɪ	‘sun’	drɛθ	drɛsɪ	‘dress’
θup	supɪ	‘soup’	aɪθ	aɪs̪ɪ	‘ice’
θoʊp	soʊpɪ	‘soap’	bʌθ	bʌsɪ	‘bus’
θtoʊv	stoʊvɪ	‘stove’	noʊθ	noʊz̪ɪ	‘nose’
θtar	starɪ	‘star’	nɔɪð̥	nɔɪzɪ	‘noise’
θnoʊ	snoʊwɪŋ	‘snow’	tʃiθ	tʃizɪ	‘cheese’
θwip	swipiŋ	‘sleep’			

The dentalization error pattern observed in the simple nonderived form of words implicates an active markedness constraint (*s) that bans the grooved coronal fricatives [s] and [z]. This particular constraint is just one member of a larger family of constraints that disfavors fricatives generally. Children exhibit considerable variation in the class of fricatives that might be excluded from their inventories, and there appears to be no discernable implicational relationship among the fricatives that will and will not occur in an inventory (e.g., Gierut 1998).

Nevertheless, [s] and [z] are acknowledged to be among the late-acquired fricatives (Smit 1993) and might reasonably be banned by a highly ranked markedness constraint. The interdental substitutes produced by the dentalization error pattern also tend to be late-acquired sounds, but again children exhibit the full range of variation in this regard. Apparently any markedness constraint disfavoring interdentals is ranked below *s for this child. Also, the fact that a fricative replaces another fricative suggests that faithfulness to manner is highly ranked.

The problem posed by the above alternation is guaranteeing target appropriate productions of /s/ and /z/ (i.e., blocking Dentalization) in the more complex derived forms of words. Since it is the morphologically simple form of words that undergo the process and are produced in error, it does not appear that derived words can be formed from a base plus an affix, as was assumed for the case of Amahl above. The solution is sketched in (7) and appears to require a different assumption about the morphology of derived words. This rather different sensitivity to morphological structure shows at least that certain words are analyzable as a string of input morphemes. The existence of morphological structure allows the generalization here to be expressed directly by a specific instance of a more general and conventional IO-faithfulness constraint, namely IO-FAITH[MC], which is understood to define a subset of all input strings.[4] This more specific instance of IO-FAITH would preserve properties only of *morphologically complex* input strings, namely those composed of a stem plus an affix. The substance of this constraint is similar to other proposed morphological and contextual restrictions associated with other faithfulness constraints (e.g., Beckman 1997; Benua 1997). The more general faithfulness constraint, IO-FAITH, would remain operative as the 'elsewhere' case of faithfulness and is ranked below the more specific case. This ranking achieves the desired result by claiming that it is more important to preserve input properties of morphologically complex words than it is to preserve the same properties in morphologically simple words. The crucial morphological assumption here is that morphologically simple words and morphologically complex words for this child are both formed from input representations, i.e., directly from one and the same input stem. This differs from the account of Amahl's derived words, which were formed from an output base (not an input stem). The context-free markedness constraint, *s, is ranked between the faithfulness constraints and accounts for the error pattern by banning grooved coronal fricatives in those contexts not affected by the more specific faithfulness constraint.

(7) Constraints and ranking

IO-FAITH[MC]: Every segment and every feature of a morphologically complex input must have an identical correspondent in the output.

*s: Avoid grooved coronal fricatives ([s] and [z]).

IO-FAITH: Every segment and every feature in the input must have an identical correspondent in the output.

Ranking: IO-FAITH[MC] >> *s >> IO-FAITH

The tableau in (8) illustrates how these constraints interact with our assumption about the morphology to yield morphologically simple words. Since an affix is not included in the input string, IO-FAITH[MC] is rendered irrelevant to the evaluation of these candidates. The faithful candidate (a) does, however, incur a fatal violation of *s and is eliminated in favor of candidate (b) with the substitute [θ]. The winning candidate does violate the general IO-FAITH constraint, but the lower ranking of that constraint renders the violation less serious. We are assuming that this child represented these words target-appropriately given the correct realizations in morphologically related forms.

(8) Morphologically simple words formed from input representation

soup	IO-FAITH[MC]	*s	IO-FAITH
a. sup		*!	
b. ☞ θup			*

The tableau in (9) illustrates how target appropriate realizations are achieved in morphologically complex words where IO-FAITH[MC] can play a crucial role. Notice that the unfaithful candidate (b) with [θ] does violate IO-FAITH[MC]. By ranking that constraint above *s, the faithfulness violation would be sufficient to eliminate candidate (b). The faithful candidate (a) is thus selected as optimal even though it violates *s.

(9) Derived words formed from concatenation of input morphemes

soupy	IO-FAITH[MC]	*s	IO-FAITH
a. ☞ supi		*	
b. θupi	*!		*

In sum, the process responsible for the Dentalization error pattern in this case applied in a nonderived environment and was blocked in a derived environment. While Amahl and Child 33 exhibited different processes, their processes were restricted in a similar way. Despite the similarity of the restriction, Amahl's process yielded no alternation but Child 33's did. To account for that difference, we had to extend the notion of a (non)derived environment and appeal to different assumptions about the morphology of derived words. Amahl formed derived words from a base plus an affix, and Child 33 formed derived words from a string of input morphemes. In the following section, we will see a different instance of the Dentalization error pattern that is restricted to a derived environment and yields an alternation. Our account will be shown to share certain properties of each of the two preceding accounts.

4. A process restricted to a derived environment with an alternation

The data in (10) are from Child 15 (age 5;1) and illustrate another instance of the Dentalization error pattern. It can be observed that target /s, z/ are produced correctly in simple, nonderived base forms of nouns and verbs. In the morphologically more complex derived forms of the same words, however, /s/ and /z/ are replaced by [θ] and [ð], respectively. The occurrence of different suffixes (including diminutive, adjectival and progressive morphemes) appears to trigger the substitution error. This might seem surprising since the presumed trigger is not always immediately adjacent to the substituted sound. That is, the variation is evident even in nonlocal word-initial contexts (10a). Of course, the alternation also occurs at the more conventional juncture of morphemes (10b).

(10) Child 15 (5;1)

a. Base:	Derived:	Gloss:	b. Base:	Derived:	Gloss:
s̪ʌn	θʌni	'sun'	dwɛs̪	dwɛθi	'dress'
sup	θupi	'soup'	aɪs̪	aɪθi	'ice'
s̪op	θopi	'soap'	dʒus	dʒuθi	'juice'
s̪ak	θaki	'sock'	woz	woði	'rose'
stov	θtovi	'stove'	noz̪	noði	'nose'
s̪wip	θwipiŋ	'sweep'	tʃiz̪	tʃiði	'cheese'
swɪm	θwɪmɪn	'swim'	bʌz	bʌðɪŋ	'buzz'

A functionally oriented account might attribute the above alternation to the presumed difficulty of producing a late-acquired (hard) sound in simple versus complex words. Thus, errors are to be expected in more complex words. It would, however, be difficult to reconcile such an account with the prior case of Child 33. Some aspects of this alternation would appear to be more or less compatible with the Alternation Condition. That is, the presumed neutralization rule is not permitted to apply in base words because of nonderived environment blocking, but is applicable in more complex words because a derived environment has been created through the morphology. This does, however, entail our extended notion of what constitutes a (non)derived environment.

Optimality theory can account for these facts with the constraints and ranking in (11). While Child 33 and 15 both exhibited some version of the same Dentalization error pattern, the two accounts will be shown to be very different. One difference relates to the assumptions about the role of morphology. For example, Child 33 was claimed to form derived words from a string of input morphemes. Child 15, on the other hand, will be claimed to form derived words from an output base plus an input affix, similar to our account of Amahl. Our account of Child 15 will, however, be shown to differ from that of Amahl in terms of the constraint hierarchy.

(11) Constraints and ranking

IO-FAITH: Every segment and every feature in the input must have a correspondent in the output.

*s: Avoid grooved coronal fricatives.

OO-FAITH: Every segment and every feature of the base must have an identical correspondent in the morphologically related form.

Ranking: IO-FAITH >> *s >> OO-FAITH

The tableau in (12) illustrates the undominated effect of IO-FAITH in the formation of morphologically simple base words such as 'soup'. Candidate (b) with an initial [θ] complies with the markedness constraint *s but fatally violates the undominated faithfulness constraint demanding that input /s/ be realized in the output. The faithful candidate (a) is thus optimal.

(12) Base words formed from input representation

soup	IO-FAITH	*s	OO-FAITH
a. ☞ sup		*	
b. θup	*!		

On the other hand, the tableau in (13) illustrates the dominance of a markedness constraint in the formation of morphologically related but more complex derived words such as 'soupy'. An important element of our account is the claim that such words are formed from an output base plus an input affix (similar to our account of Amahl) rather than from a string of conventional input segments or morphemes (cf. our account of Child 33). What serves as the base is an occurring output candidate (not an input), which is independently determined from the interaction of constraints as in (12). It happens in this instance that the base and its corresponding input are segmentally identical. However, since the input representation of a base is not directly relevant to the formation of derived words, neither of the two likely candidates incurs a violation of undominated IO-FAITH.[5] Both are equally good, passing the choice down to the lower ranked markedness constraint militating against /s/. Candidate (a) with target appropriate [s] incurs a fatal violation of *s and is thus eliminated in favor of candidate (b) with [θ]. We know in this instance that *s must be ranked above OO-FAITH because if they were unranked relative to one another, derived words would be predicted to freely vary between correct and incorrect realizations. Base words would occur correctly without variation. It is thus more important in this case to avoid /s/ in derived words than it is to preserve the correspondence between output forms. Put another way, while /s/ is disfavored as an output correspondent of a base, it is preferred as an output correspondent of an input. Such cases constitute a classic example of 'emergence of the unmarked' (McCarthy & Prince 1995). That is, an otherwise dominated markedness constraint emerges as decisive in selecting a candidate under certain circumstances.

(13) Derived words formed from /Base + affix/

Base: [sup] Input: /Base + i/	IO-FAITH	*s	OO-FAITH
a. supi		*!	
b. ☞ θupi			*

Our account of Child 33 earlier might reasonably raise a question about why the facts of derived words are not the same for Child 15, where IO-FAITH was undominated. That is, if IO-FAITH[MC] is indeed a specific instance of undominated IO-FAITH, it might seem that /s/ should have been realized correctly for Child 15 at least in derived words. One of the crucial differences is, however, that Child 15 forms derived words from a base plus an affix rather than from input strings. Aside from differences in morphology, these two children are also claimed to differ in their constraint rankings. While we have not discussed the ranking of OO-FAITH for Child 33, it can nonetheless be assumed to be present but not relevant given the child's conception of the morphology. We can thus accept without any complications the standard assumption about the default ranking of output-to-output correspondence constraints in the initial state, namely that they are ranked with the markedness constraints above IO-faithfulness (e.g., McCarthy 1999).

From a developmental perspective, it is noteworthy that Child 15 at an earlier stage (age 4;7) exhibited exactly the same version of the error pattern exhibited by Child 33. That is, the Dentalization error pattern for Child 15 at that earlier stage applied in nonderived environments and was blocked in derived environments. This is suggestive of a developmental progression and is especially interesting because we now find the same child producing /s/ correctly under just the opposite circumstances at different points in time. Importantly, however, the target sound first emerges correctly in the morphologically complex words. Taken together, these facts seem to suggest that the morphology of derived words emerges or develops. That is, derived words might begin as a morphologically simple (holistic) unanalyzable string of input segments, becoming morphologically analyzable as an input string of morphemes, and finally becoming elaborated as a base plus an affix. The constraint hierarchy also changes over time. The demotion of markedness (Tesar & Smolensky 1998) begins with *s being demoted below IO-FAITH[MC] (e.g., Child 33 and Child 15 (4;7)). A subsequent change in ranking finds *s (and OO-FAITH) demoted below both IO-FAITH[MC] and IO-FAITH (e.g., Child 15 (5;1)).

Despite the differences in our accounts of Child 33 and Child 15, there are some interesting similarities (over and above those associated with a shared error pattern). For example, Child 15 (5;1) was adduced as an example of the emergence of the unmarked. Child 33 also illustrates this with the ranking of *s between the two IO-faithfulness constraints. From a different perspective, the similarities in our accounts of Amahl and Child 15 do not fit well with the observed differences in these two cases. First, the similarity in the accounts is the appeal in both cases to output-to-output correspondence. Both children apparently conceived of derived words as a base plus an affix. Despite that commonality, their processes were restricted in opposite ways with opposite constraint rankings. Additionally, Amahl exhibited no alternation, while Child 15 did.

5. Discussion and conclusion

Each of the three cases presented here poses a different challenge for the Alternation Condition. The facts for Child 15 at the later stage (5;1) are probably the most compatible with the claims of the Alternation Condition. That is, the Dentalization process applied in a derived environment and was blocked in a nonderived environment. Additionally, an alternation resulted. However, even this more compatible case required an extended notion of a (non)derived environment. The facts relating to Child 33 were less compatible with the Alternation Condition. While the Dentalization process yielded an alternation, the process applied in nonderived environments and was blocked in derived environments. The same extended notion of a (non)derived environment had to be adopted for Child 33 and Child 15. We even saw that that notion of a (non)derived environment was relevant to Child 15 at the earlier stage (4;7) given that the facts for that stage were the same as those for Child 33. The facts relating to Amahl permitted a conventional interpretation of a derived environment, but undermined the Alternation Condition by having to impose the equivalent of a morpheme structure condition to achieve the effect of a rule restricted to a nonderived environment.

(14) Summary

	Alternation	Morphology	Process applies in	Hierarchy
Amahl	No	Base + affix	Nonderived	OO-FAITH >> M >> IO-FAITH
Child 33	Yes	Input string	Nonderived	IO-FAITH[MC] >> M >> IO-FAITH
Child 15	Yes	Base + affix	Derived	IO-FAITH >> M >> OO-FAITH

The Alternation Condition is clearly a principle that extends beyond the rule-based framework in which it was conceived. In fact, optimality theory has gone to some lengths to model phenomena accommodated by the Alternation Condition. The problem, as we see it, is that the range of phenomena is greater than might have been expected by the Alternation Condition, at least for the early stages of acquisition. Additionally, any value that might have accrued to the Alternation Condition for its role in constraining the abstractness of underlying representations is voided by richness of the base. Optimality theory can to a limited extent account for this broader range of derived environment effects, but a number of empirical and theoretical problems remain. One theoretical problem is the lack of a unified account of these developmental derived environment effects. For example, we might have expected that the commonalities and differences associated with our three case studies might have been achieved by different rankings of the same constraint types. Instead, we had to appeal to different conceptions of the morphology of derived words and a suspect IO-faithfulness constraint relativized to morphologically complex words. One of the empirical problems that remains is establishing the developmental course of events. We have some evidence that an early stage of development is instantiated by Child 33 (and Child 15 (4;7)) and a later stage by Child 15 (5;1). It is less clear where Amahl fits in this progression. The dominance in Amahl's system of OO-FAITH and *dl over IO-FAITH more closely resembles the initial state, but the morphological sensitivity to a base in the formation of derived words is more reflective of a later stage of development.

There is another similarity between Amahl and Child 33 that we have not touched on here and that is not captured by any of our accounts. That is, both children in a subsequent stage of development exhibited regressions (or overgeneralization errors) relative to their original error patterns (cf. Dinnsen & McGarrity 1999; Dinnsen et al. 2001; Dinnsen 2002). This empirical commonality connects the two case studies and is symptomatic of an early stage of development. However, there does not appear to be a straightforward theoretical mechanism for relating the two cases.

The seemingly odd and problematic sort of intra-word variation (i.e., the alternation) documented here for Child 33 and Child 15 has been shown within optimality theory to be the predicted result of plausible morphological developments and the differential ranking and demotion of independent constraints. Our focus in §§3 and 4 has been on one particular error pattern, but we want to emphasize that these same effects can be observed in other children with different error patterns. For example, the Developmental Phonology Archive at Indiana University includes other cases of intra-word variation involving alternations between affricates and non-branching singletons, between /r/ and /w/, and between onset clusters and singletons.

The general prevalence of these effects is especially striking given that the data were gathered with a very different purpose in mind. The validity of our accounts can be better assessed by future research which is specifically designed to sample a wider variety of morphologically simple base words and derived words with other affixes in this and other populations, including younger normally developing children and second language learners. Of course, still to be resolved about our account (and other optimality accounts of acquisition) is the larger question of what triggers restructuring or changes in morphology. A consideration of the development of prosodic structure and its correspondence to morphological structure as in Hannahs & Stotko (1997) would seem to be one promising approach. Additionally, it may be helpful to consider developmental changes in the organization of the lexicon precipitated by the need to better differentiate among newly added, similar sounding words in the child's lexicon (e.g., Metsala & Walley 1998).

Notes

[1] While morpheme structure conditions usually involve the co-occurrence of a phonological rule that does essentially the same work (i.e., the duplication problem (Clayton 1976)), no comparable phonological rule would be postulated in this case.

[2] Note that candidate (b) does not incur a violation of IO-FAITH under the assumption that the base is technically not an input. For a fuller discussion of this point, see Benua 1997. This assumption is, however, not crucial in this case because the decision is made by a higher ranked constraint. As we will see, this distinction between a base and an input will be crucial in the other case studies that we will be considering.

---

[3] Harris (1990) documents for Belfast English an assimilatory dentalization process that is similarly restricted to apply only in nonderived environments. One difference is that the Belfast process is not structure preserving.

[4] It is unclear to us at present why morphologically complex words in the early stages of acquisition should preserve underlying distinctions or be more resistant to change. There are, however, other alternative means available for achieving this same effect without making reference to morphology per se. For example, IO-FAITH could be locally conjoined with an anchoring constraint that demands that the right edge of a stem coincide with the right edge of a prosodic word. If the locally conjoined constraint were undominated, it would correctly assess a fatal violation mark to an unfaithful mapping of a derived word.

[5] Given freedom of analysis, it might be observed that there is another possible candidate that is phonetically identical to the winning candidate (b) but that is suboptimal, differing from candidate (b) in its morphological structure (being formed from a string of input morphemes). That candidate would be eliminated by any version of highly ranked IO-FAITH. Under the analysis that derived words are formed from a base, the faithful candidate (a) in tableau (13) is eliminated by its violation of *s. We assume that the morphological composition of derived words (i.e., whether they are formed from a base or a string of inputs) is determined by other grammatical and/or lexical demands (e.g., Dinnsen & Farris 2003).

References

Beckman, Jill. 1997. Positional faithfulness, positional neutralisation and Shona vowel harmony. Phonology, 14. 1-46.

Benua, Laura. 1995. Identity effects in morphological truncation. Papers in Optimality Theory, ed. by J. N. Beckman, L. Walsh Dickey and S. Urbanczyk, 77-136. Amherst, MA: GLSA.

Benua, Laura. 1997. Transderivational identity: Phonological relations between words. Doctoral dissertation, University of Massachusetts, Amherst.

Clayton, Mary L. 1976. The redundance of underlying morpheme-structure conditions. Language, 52. 295-313.

Dinnsen, Daniel A. 2002. A reconsideration of children's phonological representations. Proceedings of the 26th Boston University Conference on Language Development, ed. by B. Skarabela, S. Fish and A. H.-J. Do, 1-23. Somerville, MA: Cascadilla Press.

Dinnsen, Daniel A. and Barlow, Jessica A. 1998. On the characterization of a chain shift in normal and delayed phonological acquisition. Journal of Child Language, 25. 61-94.

Dinnsen, Daniel A., Barlow, Jessica A. and Morrisette, Michele L. 1997. Long-distance place assimilation with an interacting error pattern in phonological acquisition. Clinical Linguistics & Phonetics, 11. 319-38.

Dinnsen, Daniel A. and Farris, Ashley W. 2003. Grammar continuity and the prominence paradox. Unpublished manuscript, Indiana University: Bloomington.

Dinnsen, Daniel A. and McGarrity, Laura W. 1999. Variation and emerging faithfulness in phonological acquisition. Proceedings of the 23rd Annual Boston University Conference on Language Development, ed. by A. Greenhill, H. Littlefield and C. Tano, 172-83. Somerville, MA: Cascadilla Press.

Dinnsen, Daniel A. and O'Connor, Kathleen M. 2001. Typological predictions in developmental phonology. Journal of Child Language, 28. 597-618.

Dinnsen, Daniel A., O'Connor, Kathleen M. and Gierut, Judith A. 2001. The puzzle-puddle-pickle problem and the Duke-of-York gambit in acquisition. Journal of Linguistics, 37. 503-25.

Gierut, Judith A. 1998. Production, conceptualization and change in distinctive featural categories. Journal of Child Language, 25.321-42.

Gnanadesikan, Amalia. 1997. Phonology with ternary scales. Doctoral dissertation, University of Massachusetts, Amherst.

Halle, Morris. 1959. The Sound Pattern of Russian. The Hague: Mouton.

Hannahs, S. J. and Stotko, Elaine M. 1997. The non-isomorphism of phonological and morphological structure: Evidence from acquisition. Focus on Phonological Acquisition, ed. by S. J. Hannahs and M. Young-Scholten, 165-180. Amsterdam: John Benjamins.

Harris, John. 1990. Derived phonological contrasts. Studies in the pronunciation of English: a commemorative volume in honour of A. C. Gimson, ed. By S. Ramsaran. London, Routledge. 87-105.

Kiparsky, Paul. 1976. Abstractness, opacity and global rules. The application and ordering of grammatical rules, ed. by A. Koutsoudas, 160-86. The Hague, Netherlands: Mouton.

Kirchner, Robert. 1996. Synchronic chain shifts in optimality theory. Linguistic Inquiry, 27. 341-51.

Łubowicz, Anna. 1999. Derived environment effects in OT. The Proceedings of the West Coast Conference on Formal Linguistics 17, ed. by K. N. Shahin, S. J. Blake and E.-S. Kim, 451-65. Stanford, CA: CSLI.

Łubowicz, Anna. 2002. Derived environment effects in Optimality Theory. Lingua, 112. 243-80.

Macken, Marlys A. 1980. The child's lexical representation: The 'puzzle-puddle-pickle' evidence. Journal of Linguistics, 16.1-17.

McCarthy, John J. 1999. Morpheme structure constraints and paradigm occultation. CLS 34: The panels, ed. by C. Gruber, D. Higgins, K. Olson and T. Wysocki. Chicago, IL: Chicago Linguistic Society.

McCarthy, John J. 2002a. Comparative markedness. Ms., University of Massachusetts, Amherst [Rutgers Optimality Archive #489].

McCarthy, John J. 2002b. Optimality Theory: A Thematic Guide. Cambridge: Cambridge University Press.

McCarthy, John J. and Prince, Alan. 1995. Faithfulness and reduplicative identity, University of Massachusetts Occasional Papers 18: Papers in Optimality Theory, ed. by J. N. Beckman, L. W. Dickey, and S. Urbanczyk, 249-384. Amherst, MA: GLSA.

Metsala, Jamie L. and Walley, Amanda C. 1998. Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading ability. Word recognition in beginning literacy, ed. by J. L. Metsala and L. C. Ehri, 89-120. Hillsdale, NJ: Erlbaum.

Moreton, Elliott and Smolensky, Paul. 2002. Typological consequences of local constraint conjunction. Ms., Johns Hopkins University [Rutgers Optimality Archive #525].

Prince, Alan and Smolensky, Paul. 1993/2002. Optimality Theory: Constraint interaction in generative grammar. Report No. RuCCS-TR-2. New Brunswick, NJ: Rutgers University Center for Cognitive Science.

Smit, Ann B. 1993. Phonologic error distributions in the Iowa-Nebraska Articulation Norms Project: Consonant singletons. Journal of Speech and Hearing Research, 36. 533-47.

Smith, Neilson V. 1973. The Acquisition of Phonology: A Case Study. Cambridge: Cambridge University Press.

Stanley, Richard. 1967. Redundancy rules in phonology. Language 43. 393-436.

Tesar, Bruce and Smolensky, Paul. 1998. Learnability in optimality theory. Linguistic Inquiry, 29. 229-268.